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Experimental Study on Concrete Mix Design by replacing Fine aggregate by Crushed tiles & Cement With marble powder

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Abstract: Concrete is one of the oldest manufactured construction material used constructions of various structures around the world. Due to its high demand the material used for concrete production depleting every year. Thus, around the world new construction materials are being investigated. In this study ceramic waste was used as replacement of fine aggregate and marble waste used as replacement of cement. The scope of the study includes the investigation on the compressive strength. The method of study to be carried out is through the appropriate test on aggregate, sand, cement, marble slurry and ceramic powder. The entire tests have been carried out and the results had been recorded and analysed in appropriate table.
Keywords: Marble slurry, Concrete, Ceramic waste, Cement, Compressive strength.

I. INTRODUCTION

Concrete is one of the oldest manufactured construction material used in construction of various structures around the world and the most widely used in all types of civil engineering works, including infrastructures, low and high rise building, defence installation, environment protection and local or domestic developments. It is a construction material obtained by mixing a binder (such as cement, sand, aggregate) and water in certain proportions. The use of sand in construction activities results in the excessive mining, causing depletion of natural resources resulting increase in scour depth and sometimes flood possibility. Ceramic waste is most commonly produced from ceramic industry
whereas Marble powder from processing plants during the sawing and polishing of marble blocks.

Ceramic waste is seen as non-hazardous solid waste and possesses Pozzolonic properties Therefore, after recycling can be reused in different building construction application Marble is a metamorphic rock produced from limestone by pressure and heat in the earth's crust due to geological process Marble Dust Powder is an industrial waste made from cutting of marble rock. The rapid growth of industrialization gave birth to numerous kinds of waste by products which are environmentally hazard and creates problems of storage.

Always, construction industry has been at forefront in consuming these waste products in large quantities. The utilization will also reduce the strain on supply of natural fine aggregate, which will also reduce the cost of concrete. Using artificial Aggregates for quality concrete is a natural step to mitigating this problem. The World Wide consumption of fine aggregate in concrete production is very high, and several developing countries have encountered difficulties in meeting the supply of natural fine aggregate in order to satisfy the increasing needs of infrastructural development in recent years. To overcome the stress and demand for river fine aggregate, researchers and practitioners in the construction industries have identified some alternative materials such as fly ash, slag, limestone powder and siliceous stone powder, ceramic dust etc.

A. *Objectives of the Project*

1) To provide some information about the use of ceramic and marble waste in concrete.
2) To reduce the consumption of natural resources.
3) To compare the ceramic-marble concrete with conventional concrete.
4) To achieve economy and environment saving.
5) To increase the compressive strength of concrete by using ceramic waste and marble slurry.

B. *Methodlogy*

How the project will work ?

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Thus project aims at providing information on OPC cement concrete where the Marble powder is partially replaced with cement to make it light in weight and providing and economical construction material. Firstly, the selection of the site is to be Done thereafter, collection of material. Then, the mix design for blocks will be Calculated. After that the materials should undergo tests as mentioned in planning. Afterwards the concrete blocks should be casted according to the satisfactory standards Of IS : 456 2000. After period of 28 days of casting and resting, the blocks should be Tested on
Compressive Testing Machine (CTM) to know the
Compressive Strength of Casted block

C. Mix Design for M35

Specific Gravity of Cement: - 3.14
Specific Gravity Coarse Aggregates: - 2.83
Specific Gravity Fine Aggregates: - 2.642.73
Specific Gravity of Water: - 1

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(Clauses 6.1.2, 8.2.4.1 and 9.1.2)

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	–	300	0.55	M 20
ii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

NOTES
1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.
2 Minimum grade for plain concrete under mild exposure condition is not specified.

Table 3 Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate

(Clauses 4.4, A-7 and B-7)

Sl No.	Nominal Maximum Size of Aggregate mm	Volume of Coarse Aggregate[1] per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate			
		Zone IV	Zone III	Zone II	Zone I
(1)	(2)	(3)	(4)	(5)	(6)
i)	10	0.50	0.48	0.46	0.44
ii)	20	0.66	0.64	0.62	0.60
iii)	40	0.75	0.73	0.71	0.69

[1] Volumes are based on aggregates in saturated surface dry condition.

Target Mean strength = fck + t + s
=35 + 1.6 x 5
= 43.25 N/mm2

Where, f'ck = Target Mean Compressive Strength fck = Characteristic Compressive Strength S = Standard Deviation from IS 456:2000 1.65 = Tolerance factor.

D. Water - Cement Ratio

Referring IS Code 456 2000 table no. 5.
1. Water Content
Note: Referring IS Code 10262 2009, table no. 2.

i. As per IS code 10262 2009, maximum water content for 20mm coarse aggregate = 186 litres or kg. This will give use slump of 20-25mm according to clause 4.2 of IS code 10262 2009.
ii. Whereas , Target Slump Value is 150-175mm.
186 litres gives us the slump of 50mm. Hence, for desired workability we can increase water content by 3% for every additional 25mm of slump. (As mentioned in IS Code 10262 : 2009, clause 4.2).

∴ Target Slump – Std. Slump value (according IS codes)
= 150 – 50
= 100mm
After this if you will divide the value with 25 you'll get the no. parts of slump proportion.
i.e. 100 /25
= 4 (parts of 25mm Slump)
= 4 x 3
= **12%** (amount of water content to be added)
∴ Corrected water content =186 + (12/100 X 186)
= 208.32
∴ Corrected water content = **208.32 litres**.

II. MATERIALS

A. Cement

1) Minimum Cement Content = 300kkg/m3

Water cement ratio = 0.45 – 0.05
= 0.40

Water Content = 208.32 litres

2) Cement content calculations,

Cement Content = Water Content / Water-Cement ratio
= 208.32 / 0.40 **= 520.8 kg/m3** i.e. **520** > **300**

∴ It is Ok

B. Coarse Aggregates & Fine Aggregates

1) Selecting proportion for aggregate from IS 10262.

The selected proportion for C.A. was **0.64**

2) Corrections**,**

Std. w/c ratio = 0.50 ; Actual w/c ratio = 0.45

It is reduced by 0.05 which means, as the ratio get decreased it is necessary to increase the proportion of aggregates. As IS 10262 : explains specific rule for it, i.e. **for every 0.05 w/c ratio deduction it is necessary to add 0.01 in aggregate proportion.**

∴ Corrected proportion for C.A. = 0.64 + 0.01
= 0.65

Since, we are using angular aggregates & concrete should be pump able, the C.A. can be reduced by 10%

∴ Corrected proportion for C.A. = (10/100 X 0.65)
= 0.585

Whereas, proportion for F.A. = 1 – 0.585
= 0.415

III. DESIGN MIX CALCULATION

1) Volume of concrete = 1m3 _(a)

2) Volm of Cement = Mass of Cement / (Specific Gravity of Cement X 1000)
= 520.8 / (3.14 X 1000)
= 0.165 m3 _ (b)

3) Volm of Water = Mass of Water / (Specific Gravity of Cement X 1000)
= 208.32 / (1 X 1000)
= 0.20832
=0.162 m3 _(c)

4) Volm of entrapped air,

As per IS code, there should not be entrapped air exceeding 0%. But, on practical basis 2% is permissible. Therefore, the volm of entrapped air is considered as 2% i.e. 0.02 m3.

5) Volm of all aggregates = [a - (b + c)]

= 1 – (0.165 + 0.208)
= 0.627 m3

a. Mass of C.A. = Volm of all aggregates x Proportion of C.A. x Sp. Gravity of C.A. x 1000

= 0.627 x 0.585 x 2.83 x 1000
= 1038.02 kg/m3

b. Mass of F.A. = Volm of all aggregates x Proportion of F.A. x Sp. Gravity of F.A. x 1000

= 0.627 x 0.415 x 2.73 x 1000
= 710.35 kg/m3

6) Volm of marble powder , As we're, replacing cement with marble powder on percentage basis of 12%. The calculations are carried out as following :

Volm of Marble powder = 12/100) x Volm of all cement

= (12/100) x 0.165
= 0.198 m3

vii. Volm of crushed tiles as we're, replacing fine aggregates with crushed tiles on percentage basis of 12%. The calculations are carried out as following:

Volume of Crushed tiles = (12/100) x Volume of all aggregates
= (12/100) x 0.627
= **0.075 m3**

IV. MIX PROPORTION

Cement : 520 kg/m3
Water : 181.82 litres/m3 or kg/m3
Coarse Aggregates : 1038.02 kg/m3
Fine Aggregates : 710.35 kg/m3
W/C Ratio : 0.40
Marble powder : 0.198 kg/m3
Crushed tiles : 0.075 kg/m3

Compressive strength of conventional cubes

Sr. no	Days	Load	Compressive Strength(MPa)	Average
1	7	598	26.5	28.0
		622	27.6	
		678	30.1	
2	14	496	22	25.9
		569	25.2	
		687	30.5	
3	28	649	28.8	28.9
		663	29.4	
		646	28.7	

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Compressive strength of cubes by adding 12% marble and 12% ceramic

Sr. no	Days	Load	Compressive Strength(MPa)	Average
1	7	648	28.8	35.5
		870	38.6	
		886	39.37	
2	14	593	31.4	30.4
		708	33.6	
		756	26.3	
3	28	853	37.9	42.0
		949	42.1	
		1037	46.0	

Compressive strength of cubes by adding 13% marble and 13% ceramic

Sr. no	Days	Load	Compressive Strength(MPa)	Average
1	7	548	24.3	26.3
		587	26	
		650	28.8	
2	14	688	30.5	31.0
		690	30.6	
		718	31.9	
3	28	656	29.1	30.7
		680	30.2	
		743	33	

Compressive strength of cubes by adding 14% marble and 14% ceramic

Sr. no	Days	Load	Compressive Strength(MPa)	Average
1	7	554	24.6	26.6
		593	26.3	
		656	29.1	
2	14	695	30.8	31.3
		697	30.9	
		726	32.2	
3	28	663	29.8	31.2
		687	30.5	
		750	33.3	

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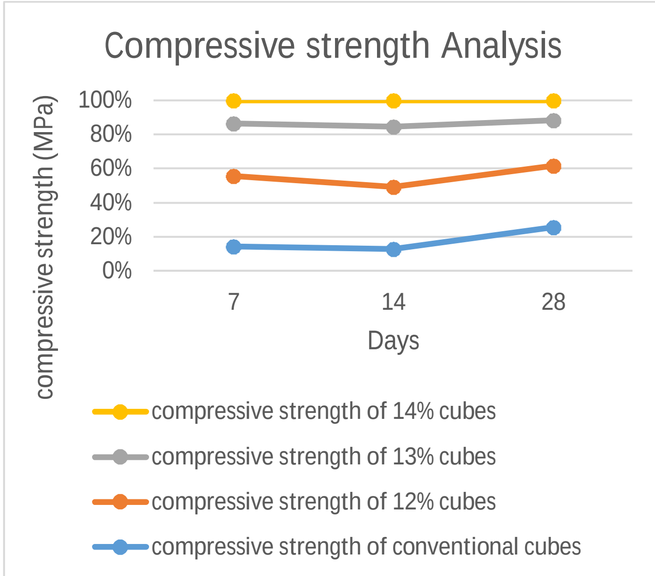


Comparison between Conventional and Marble-Ceramic Concrete

V. CONCLUSION

The basic objective of the study is to prepare a concrete much more stable and durable than the conventional by replacing fine aggregate and cement. Mix design for all the replacements of materials has done and a total of 54 cubes are prepared and tested in the aspect of strength calculation and also comparison has done.

As compared to conventional concrete, on addition of marble slurry and ceramic waste its characteristic strength is gradually increased up to 12% marble slurry and 12% ceramic powder. There after compressive strength was found to be decrease for 13% marble and 13% ceramic waste.

Utilization of ceramic waste and marble waste and its application for sustainable development of the construction is the most effective solution.

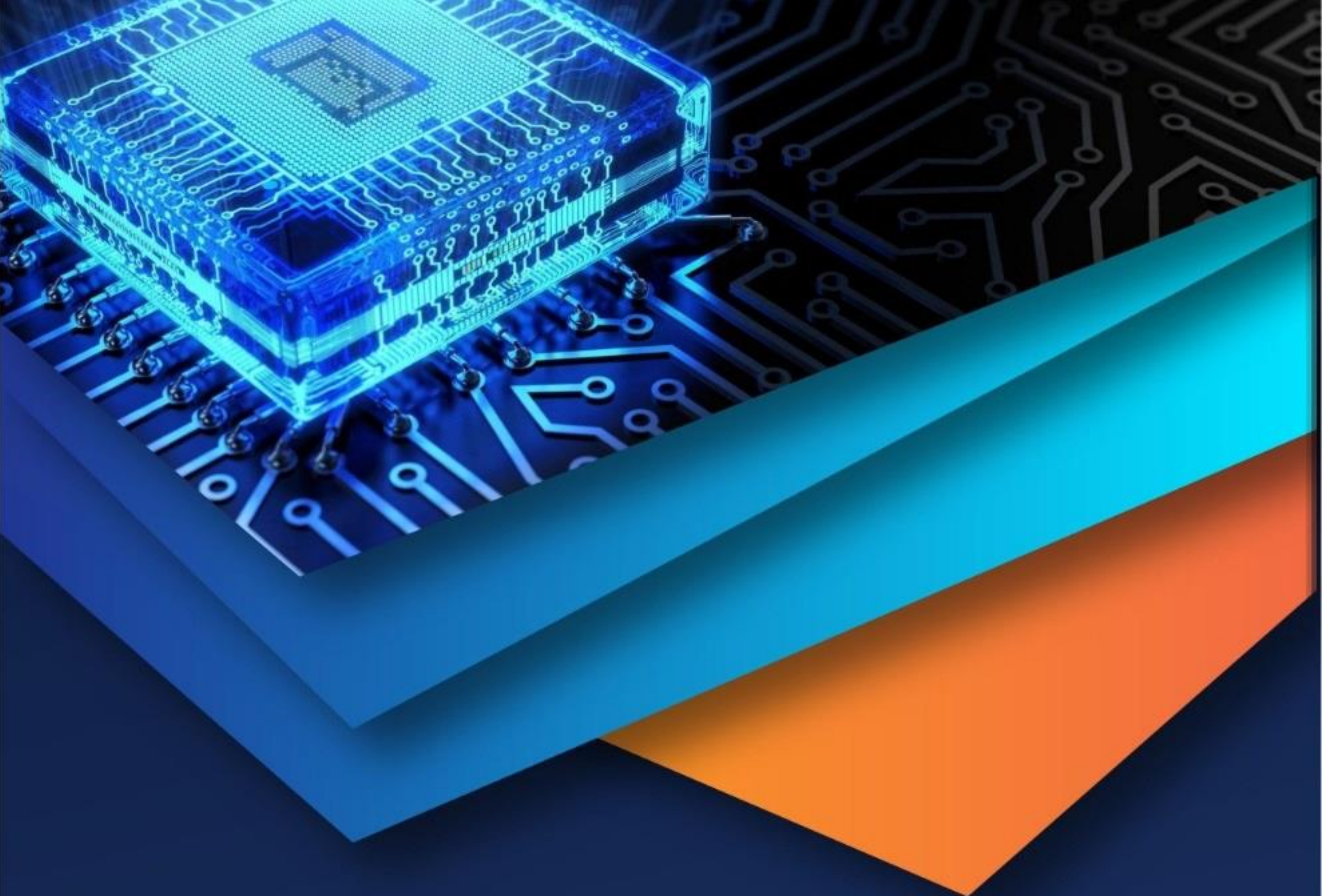
It is the best possible alternative solution of safe disposal of the ceramic waste and marble waste and thus stepping into a solving environmental pollution.

VI. FUTURE SCOPE

1) The use ceramic-marble concrete as a structural concrete. eg. Residential building.
2) It can also use as a non-structural concrete. Ex. Compound wall, garden paver block etc.
3) By the use ceramic tile aggregate in concrete the physical properties like durability permeability etc. Can be analysed to prepare a concrete with more advantage then conventional concrete.
4) Ceramic tile aggregate in high strength concrete can be studied further to check the possibility of its use in high rise buildings.

REFERENCES

[1] Concrete technology by S.Chand.
[2] Fundamentals of concrete technology by Pearson Education
[3] IS code –IS 4031-1988
[4] IS Code- IS 383-1970
[5] IS Code- IS 456-2000, IS 1062-2009
[6] International journal innovation research in science, engineering and technology
[7] https://photos.app.goo.gl/yvtPJRs3hazUN4hG7
[8] https://photos.app.goo.gl/ufWCVNHfSTHj4nvNA
[9] https://photos.app.goo.gl/qFoQ92fz8pM4PD2E8
[10] https://photos.app.goo.gl/MEvWV2zvfDSUNCxG6



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