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Experimental Study of Partial Replacement of Cement in Concrete with Marble Dust and Recron Fibre as Admixture

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1. INTRODUCTION

The advancement of concrete technology is abridging the usance of natural and energy asset, and lessen the pollution of environment by the industrial waste. Marble is a metamorphic rock, resulting from the transformation of pure lime stone. Marble dust is generated in stone processing plants which pollute the environment and affect the humans directly or indirectly. Marble is industrially processed by being cut, polished and used for decorative purpose and thus, economically variable. During cutting process, 20%-30% of a marble block becomes waste marble powder.

Factories in India raise lots of waste which possibly utilitarian in partial subrogation of all the raw materials due to their different properties. This written report includes expend of waste marble powder as a partial subrogation of fine aggregate or Cement.

Since high metallic content present in marble residue that make the water unhealthy for use. Since this residue has richer oxide amount, calcium matter that has binding capacity, marble can be used as in the partial replacement of cement in mixture of sand-Cement. In this project work, collect the waste marble residue from the factories, plants and examine its outcome on the Sand-Cement mixture in various proportions and comparison the compression capacity of cement-sand mixture, durability and workability. The major purpose of this report is to invest usable concrete mixture used with worthless marble dust as partial substitution of sand and cement. Decreasing the residual material and investing for the future.

Recron fibres are expend in the concrete as an admixture, Recron acts as "secondary reinforcement" in concrete which increases resistance to impression/excoriation, arrests cracks & greatly improves quality of construction in walls, tank, foundations, roads and pre-cast products like pipes, blocks, tiles, manhole covers, and more. The new generation fibre used in a variety of significant industrial applications such as paper, lead acid battery, cementic products and construction sector. Recron fibre also expand compression capacity and durability of concrete and make the concrete additional ecologically pure and will give extra life to concrete. The quantities of recron fibre are 1%, 2% and 3% of weight of cement. In this study, characteristics of concrete in hardened state produced residual marble dust used admixture or coarse/fine aggregates in the concrete mix was examined in detailed manner. Additionally, it was determined that possibility of usage of these waste in the concrete as admixture material or aggregate affected positively on the hardened properties of concrete. Consequently studies in the literature related hardened properties of concrete produced waste marble were examined.

The project describes the feasibility of using marble dust with partial replacement of cement. Various cubes were casted by using marble dust with partial replacement of cement, MDP used as a Admixture in Conventional concrete and recron fibre in conventional concrete with MDP in various percentage (5%, 10% and 15%) and compressive strength test were done after 7 days and 28 days curing using universal testing machine (U.T.M) in order to determined the optimum percentage of marble powder by weight, that provide the peak compressive strength of Specimens.

The marble processing factories in INDIA is one of the most booming industries. The behavior of different percentage marble powder contain on the various physical characteristics of fresh and harden concrete mass has been examined.

Cement used in this experimental work is PORTLAND POZZOLANA CEMENT of 53 grade conforming to IS:1489(Part 1)-1991. The physical and chemical properties of Portland pozzolana cement obtained on conducting appropriate test as per IS: 269/4831 and the requirements as per IS:1489-1991. The particles of Portland pozzolana cement have spherical in shape and they have grater fineness values. Due to spherical shape concrete move freely and also free from filling the pores, because of spherical shaped fine particles automatically fill the pores if required. Crushed granite of 20mm maximum in size has been used as a coarse aggregate. The sieve analysis of combined aggregate conforms to the specification of IS: 383-1970 for graded aggregates.

2. LITERATURE REVIEW

The aim of this research is to develop the high strength concrete with the utilization of a waste product of marble dust powder. The marble dust powder possesses good Pozzolanic activity and is a good material for the production of concrete. Also now a day's one of the great applications of marble dust powder is in various structural fields as in reinforced cement concrete, which is gaining popularity because of its positive effect on various properties of concrete. Although, deep interest in studies of marble dust powder utilization has been developed during last six to seven decades, the latest research work is given below.

Ulubeylia et al (2015) [1] was investigated that the effect of different usage areas of waste marble on the hardened concrete, In this context, (1) compressive, flexural, and splitting tensile strength, (2) modulus of elasticity, (3) ultrasonic pulse velocity, (4) Schmidt surface hardness, and lastly (5) sorptivity coefficient/porosity of the hardened concrete, were examined. Compared all the results, the proposition "the marble waste can be used in the production of concrete" As a result, the use of waste marble powder in (1) conventional concrete mix, (2) self-compacting concrete mix, and (3) polymer concrete mix, was revealed. Consequently, author found that the use of waste marble in the conventional concrete mix as an admixture material or aggregate is suitable as it can improve some properties of the hardened concrete. However, the use of waste marble in the self-compacting and polymer concrete mixes as an admixture material or aggregate is not affected positively in terms of hardened properties of concrete.

Jain et.al (2016) [2] has been used different waste materials as a partial replacement of cement or fine aggregate or coarse aggregate. Industries in India produce lots of waste which may be useful in partial replacement of all the raw materials due to their different properties so hereby we studied as many useful research papers in this field and trying to improve with locally available waste material so it can be proved economical as well. Research in this field and positive results are crucial so as to continue all developments with least damage to surrounding environment and obtaining all infrastructures for services and convenience which are desired to get.

While production of cement CO_2 is emitted out. Replacement of cement by a pozzalanic material named Ground Granulated Blast Furnace Slag, which is byproduct or waste product of steel manufacturing industries. Ground Granulated Blast Furnace Slag act as cost reducing ingredient and also increase many mechanical properties of concrete. Glass fibres of 12mm size were also added to increase both compressive and tensile strength of concrete. This concrete is more environments friendly and will give more life to concrete. To maintain workability for lower water/cement ratio and to maintain the effect of admixture added, Super plasticizer is added by trial and error method. Mechanical properties of pozzalanic concrete using GGBFS show that this concrete gives better compressive strength and increases durability of concrete. Glass fibre also increases mechanical properties like compressive strength, flexural strength and split tensile strength of concrete. Test has been conducted on concrete using the supplementary admixture. The compressive strength of 0.2% fibre content is maximum at 28 days curing, The 28 days splitting tensile and flexural strength also increases about 5% at 0.2% fibre content to that of normal concrete and Further if fibre percentage increases then it was seen a great loss in the strength, was investigated by **Priya et.al (2015) [3].**

The waste MDP passing through 90 microns, has been used for investigating of hardened concrete properties. Furthermore, the effect of different percentage replacement of MDP on the compressive strength, splitting tensile strength (Indirect tensile strength) & flexural strength has been observed by **Ranjan Kumar et.al (2015) [4],** In this project, the effect of MDP in concrete on strength is presented. Five concrete mixtures containing 0%, 5%, 10%, and 20% MDP as cement replacement by weight basis has been prepared. Water/cement ratio (0.43) was kept constant, in all the concrete mixes. Compressive strength, split tensile strength & flexural strength of the concrete mixtures has been obtained at 7 and 28 days. The results of the laboratory work showed that replacement of cement with MDP increase up to 10% for compressive strength, & up to 15% for split tensile strength & flexural strength of concrete.

3. MATERIALS AND METHODOLOGY

3.1. Materials Used

3.1.1. Cement:

A binding element or agency: such as a powder of alumina, silica, lime, iron oxide, and magnesium oxide burned together in a kiln and finely pulverized and used as an ingredient of mortar and concrete.

Cement used in this experimental work is PORTLAND POZZOLANA CEMENT of 53 grades conforming to IS: 1489(Part 1)-1991. As per IS: 269/4831 the Physical and chemical properties of PPC cement obtained by appropriate testing and as per IS: 1489-1991 the requirements are given in **Table 3.1** and **Table 3.2**.

Table 3.1: Physical Properties of Procured PPC

S. No.	Particulars	Test result
1	Specific gravity	3.15
2	Fineness (sieve analysis)	2.12 %
3	Normal consistency	30%

Table 3.2: Chemical Properties of Procured PPC

S. No.	Particulars	Proportion (%)
1	Calcium oxide(CaO)	62.91
2	Silicon dioxide(SiO_2)	19.17
3	Aluminum oxide (Al_2O_3)	5.20
4	Iron oxide(Fe_2O_3)	3.73
5	Sulphur oxide (SO_3)	2.72
6	Magnesium oxide(MgO)	2.54
7	Ignition loss(LOI)	0.96
8	Potassium oxide(K_2O)	0.90
9	Sodium oxide(Na_2O_3)	0.25

3.1.2. Fine Aggregate

Sand is also one of the main ingredients of the concrete which helps to aggregate and cement bond properly. The size of sand is less than 4.75mm sieve.

The natural sand which is easily available in near about location and low in price was used in this work. it had cubical or rounded in shape with smooth surface texture. The cubical rounded shape and smooth texture give a good workability to the concrete. Sand which is used in this project is taken from ARPA RIVER Bilaspur.

Table 3.3 Sieve Analysis of Fine Aggregate (IS: 383-1970)

S. No.	IS Sieve size	Weight retained (gm)	% Weight retained	Cumulative % weight retained	% Passing	Grading zone II
1	10mm	0.0	0.0	0.0	100	100
2	4.75mm	0.0	0.0	0.0	100	90-100
3	1.36mm	0.0	0.0	0.0	100	75-100
4	1.18mm	140	1400	14.00	86.00	55-90
5	600micron	390	39.00	53.00	47.00	35-59
6	300micron	355	3550	88.50	11.50	8-30
7	150micron	105	1050	99.00	1.00	0-10
8	Pan	10	-	-	-	-
9	Total	1000		254.50	-	-

Fineness Modulus: 254.5/100= 2.54

Note –Fineness Modulus should be between 2.0-3.5 as per IS specification

Table 3.4 Physical Properties of Fine Aggregate (IS: 2386-1963)

S. No.	Properties	Results	Permission limit as per IS: 2386-1963
1	Organic impurities	Colorless	Colorless /Straw Color /Dark color
2	Silt content	1.85%	Should not be more than 6-10%
3	Specific gravity	2.63	
4	Bulking of sand	7.52%	Should not be more than 40%
5	Free moisture content	2.0%	-

3.1.3. Coarse Aggregate

A material or structure formed from a mass of fragments or particles loosely compacted together. Aggregate are the main ingredient of the concrete which gives the ultimate strength to the building.

The coarse aggregates used in the experimentation ware 12mm and down size and tested as per IS: 383-1970 and 2386-1963 (I, II and III) specifications. Sieve analysis of coarse aggregates is given in **Table 3.5** and physical and mechanical properties of tested coarse aggregates are given in **Table 3.6**. Specific gravity of coarse aggregate was found to be 2.6.

Table 3.5 Sieve Analysis of Course Aggregate (IS: 383-1970)

S. No.	IS Sieve size	Weight Retained (gm)	% Weight retained	Cumulative % weight retained	% Passing	Grading zone II
1	12.5mm	0.00	0.00	0.00	100	90-100
2	10mm	1905	47.63	47.63	52.37	40-85
3	4.75mm	1815	45.37	93.00	7	0-10
4	Pan	280	-	-	-	-
5	Total	4000	-		-	-

Table 3.6 Physical and Mechanical Properties of Coarse Aggregate (IS: 2386-1963)

S. No.	Properties	Results	Permission limit as per IS: 2386-1963
1	Impact value	15.50%	Should not be more than 30% used of concrete
2	Crushing value	14.98%	Should not be more than 30% for surface coarse and 45% other than wearing coarse
3	Loss Angeles Abrasion Value	17.2%	-
4	Flakiness Index	20.67%	-
5	Specific gravity	2.6	-
6	Water absorption	0.5%	-
7	Fineness modulus	6.816	

3.1.4. Water

Ordinary portable water is free from turbidity, organic content and salt was used for mixing the materials and curing throughout the investigation in the project work.

3.1.5. Waste Marble Powder

Marble dust used in this project was procured from marble Processing plant Bhopal. These dusts are very harmful for human health as well as animal and plants. With the use of these waste material the quantity of waste material can be minimize. Hence it is a waste optimization technique. With the replacement of cement by marble dust powder we can achieve a greener construction.

Marble occurs in large deposits which can be hundreds of feet thick and geographically extensive. Quarries and mines produce large amount millions of tones per year. In building foundation, highways, railway beds as aggregates crushed stones are used and also in some other construction works.

Dimension stones are obtained through sawing marble in pieces of defined dimension. This is also useful in the building, monuments, paving, sculptures and other projects

3.1.6. Recron Fibre

Recron has undergone years of Research and Development at Reliance Technology Centre; RIL's in-house state of art R & D centre situated at Patalganga, Mumbai. Where we have a forward and backward integrated manufacturing facilities right from crude to fibres, Bringing the advantage of economy of scale, High quality and lower operating cost. We also have access to a wide range of manufacturing technology giving us unique advantage in production, manufacturing and development.

Recron acts as "secondary reinforcement" in concrete which increases resistance to impact/abrasion, arrests cracks & greatly improves quality of construction in walls, tank, foundations, roads and pre-cast products like pipes, blocks, tiles, manhole covers, and more. The new generation fibre used in a variety of significant industrial applications such as paper, lead acid battery, cement products and construction.

Table 3.7 Specification of Recron Fibre

S. No.	Properties	Unit	Value
1	Chemical Composition		Modified Polyester
2	Cross-Section		Triangular
3	Diameter	Micron	30-40
4	Elongation	%	> 100
5	Cut Length	Mm	6, 12 & 18
6	Moisture Flat	%	< 1.0
7	Melting Point	0C	240-260
8	Softening Point	0C	220
9	Sp. Gravity	Cc/g	1.34-1.40

Fibre Dosage and Length Design Aspect

Micro fibre (6-18mm length) Used @ 0.25 - 0.35 % by Cement Weight
Cost Impact – Rs. 320-430 per Cum
Target – Reduce Shrinkage/Improve Abrasion /Improve Impact/Improve Energy Absorption/Reduce Crack Width to 300 microns
Structural Synthetic Fibre Used @ 0.75 – 3% by weight of cement
Cost Impact – Rs.1200-2000 per Cum

Target – Reduction in Pavement Thickness/Multiplication in Impact Strength/Multiplication in Energy Absorption/Reduce Crack Width and Substitute NSW or Nominal Steel.

Fig – 3.1: Recron Fibre

3.2. Mix Proportion

The Quantities of Materials for Concrete is Calculated

For given mix proposition the quantities of materials for the production are required. For the given mix proposition the quantity of concrete can be calculated by absolute volume method. This absolute method is based on the principle of that the absolute volume of all the materials of concrete, i.e. cement, sand, coarse aggregates and water is equal to the volume of fully compacted concrete.

The Concrete structure may consists of the following building units such as beams, slabs, columns and foundations etc. based on the type of the structure. The volume of concrete required for the construction of concrete structure can be calculated by summing up all the volumes of each structural member or each parts of building members. The volume of a rectangular cross sectional of structural member can be calculated as length x width x height (or depth or thickness). For different cross-sectional shapes of members the suitable formulas shall be used.

The formula used for the calculation of materials for volume of concrete required is given by:

$$V_C = \frac{W}{1000} + \frac{C}{1000Sc} + \frac{Fa}{1000fa} + \frac{Ca}{1000Sca}$$

Where, V_c = Fully compacted fresh concrete absolute concrete
W = Mass of water
C = Mass of cement
Fa = Mass of fine aggregates/coarse aggregate
Ca = Mass of coarse aggregates
S_c, S_{fa} and S_{ca} are the specific gravities of cement, fine aggregates and coarse aggregates respectively.

The air content has been ignored in this calculation.
This method of calculation for quantities of materials for concrete takes into account the mix proportions from design mix or nominal mixes for structural strength and durability requirement.

Calculating Quantities of Materials for per cubic meter

Consider concrete with mix proportion of M-20 (1:1.5:3) where, 1 is part of cement, 1.5 is part of fine aggregates and 3 is part of coarse aggregates of maximum size of 20mm. The water cement ratio required for mixing of concrete is taken as 0.50.

Assuming bulk densities of materials per cubic meter

Cement = 1500 kg/m^3
Sand = 1700 kg/m^3
Coarse aggregates = 1650 kg/m^3

Specific gravities of concrete materials are as follows:

Cement = 3.15
Sand = 2.6
Coarse aggregates = 2.6.
The percentage of entrained air assumed is 2%.

Target mean strength

The target mean strengths for the specified characteristics cube strength is
Fck = fck + 1.65S
Refers to the IS table, for M20 concrete and good quality control,
Where,
Standard deviation S = 4.6
Fck = 20 N/mm^2
Thus, Target Mean Strength (TMS) = 20 + 1.65 x 4.6
TMS = 27.59 N/mm^2

The mix proportion of 1:1.5:3 by dry volume of materials can be expressed in terms of masses as:

Cement = 1 x 1500 = 1500
Sand = 1.5 x 1700 = 2550
Coarse aggregate = 3 x 1650 = 4950.

Therefore, the ratio of masses of these materials w.r.t. cement will as follows =

$$1 : \frac{2550}{1500} : \frac{4950}{1500}$$

= 1 : 1.7 : 3.3

The water cement ratio = 0.50

Now we will **calculate the volume of concrete** that can be produced with one bag of cement (i.e. 50 kg cement) for the mass proportions of concrete materials.

Thus, the **absolute volume of concrete** for 50 kg of cement =
Vc=(0.50x50/1000) + (1x50/1000x3.15) + (1.7x50/1000x2.6) + (3.3x50/1000x2.6)

Thus, for the proportion of mix considered, with one bag of cement of 50 kg, 0.1374 m^3 of concrete can be produced.

We have considered an entrained air of 2%. Now we can say 1 -0.02 = 0.98 m^3 would be the actual volume of concrete for 1 cubic meter compacted concrete mass.

Now required cement quantity for 1 Cum concrete = 0.98/0.1374 = 7.132 bag cement.

Quantity of material for 1 m3 of concrete production will be calculated as following:
The quantity of cement required = 7.132 x 50 = 356.66 kg.
Quantity of fine aggregate (sand) = 1.5 x 364.5 = 546.75 kg.
Weight of coarse aggregate = 3 x 364.5 = 1093.5 kg.

The quantities of materials for 0.003375 m^3 (150mm X 150mm X 150mm Cube) of concrete production can be calculated as follows:

The weight of cement required = 0.003375 x 356.66 = 1.2 kg.
Weight of fine aggregate (sand) = 0.003375 x 546.75 = 1.85 kg.
Weight of coarse aggregate = 0.003375 x 1093.5 = 3.7 kg.
Weight of Recron Fibre = 1% of weight of Cement = 12 gm

4. RESULTS AND DISCUSSION
4.1. COMPARISON OF TEST RESULTS
4.1.1. Test Result on Cement

Table 4.1 Initial Setting Time of Cement

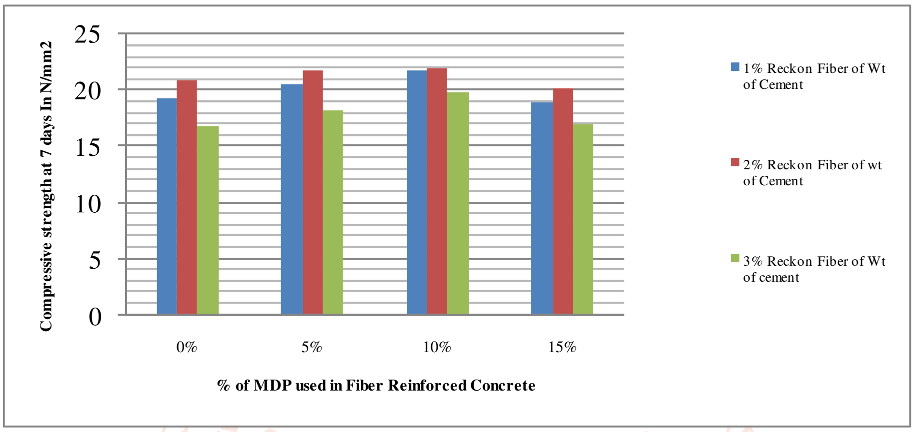
Cement	% of cement replaced with marble dust powder		
	5%	10%	15%
34 min	40min	43min	44min

Table 4.2 Final Setting Time of cement

Cement	% of cement replaced with marble dust powder		
	5%	10%	15%
9h 10 min	8h 10min	7h 15 min	7h 5 min

Table 4.3 Compressive strength of Fibre Reinforced Concrete Cubes where MDP used as an admixture (N/mm2)

Days of curing	% of MDP	1% Recron Fibre of wt of cement	2% Recron fibre of wt of Cement	3% Recron Fibre of wt of Cement
7 days curing	0	19.4	20.9	16.80
	5	20.6	21.86	18.2
	10	21.8	22.02	19.8
	15	19.01	20.20	17.1
28 days Curing	0	22.3	25.11	18.35
	5	23.5	26.80	21.4
	10	25.2	27.6	23.3
	15	21.10	24.9	19.2



Graph 4.1 Compressive strength of Conventional Concrete at 7 & 28 days of MDP used as an Admixture

According to this graph the highest compressive strength were achieved by 10% adding of marble dust powder and 2% of Recron fibre, and then adding extra percentages of marble dust powder and Recron fibre then the compressive strength were starts to decreases.

Table 4.4 Compressive strength of Fibre Reinforced Concrete Cubes where MDP used as an admixture (N/mm2)

Days of curing	% of MDP	1% Recron Fibre of wt of cement	2% Recron fibre of wt of Cement	3% Recron Fibre of wt of Cement
7 days curing	0	19.4	20.9	16.80
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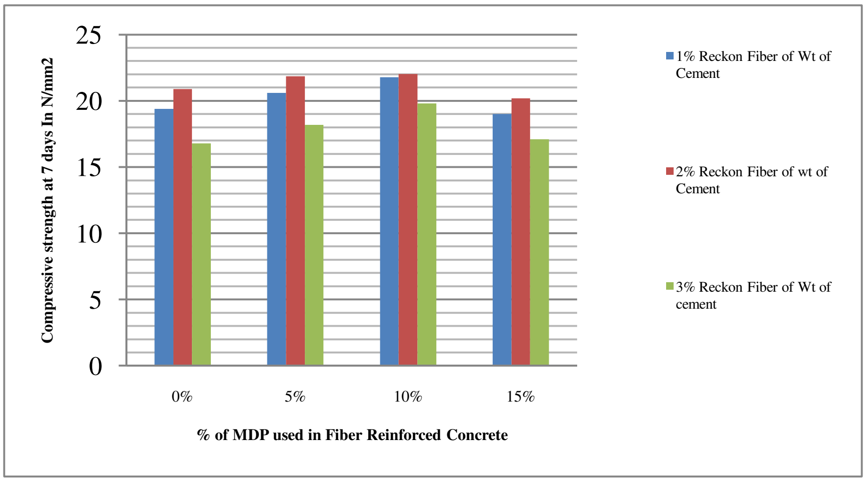
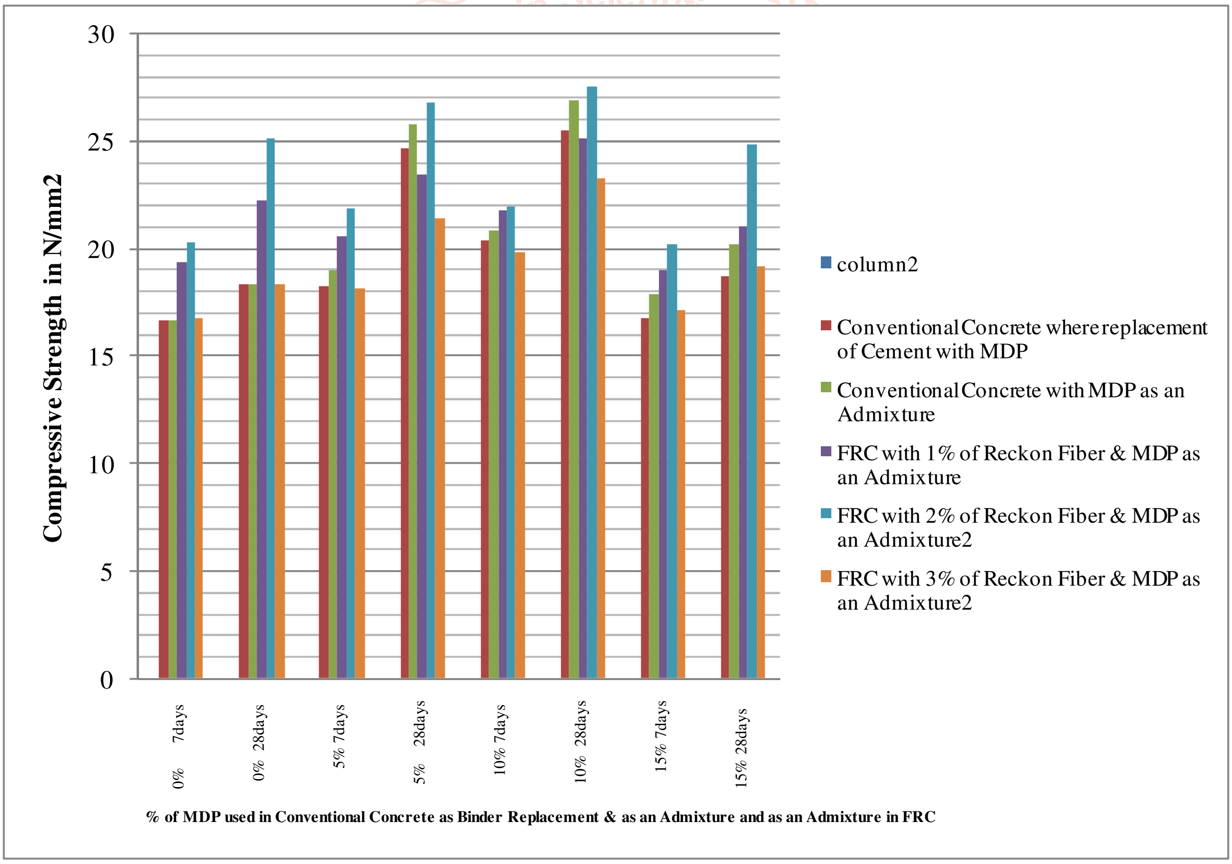
	10	21.8	22.02	19.8
	15	19.01	20.20	17.1
28 days Curing	0	22.3	25.11	18.35
	5	23.5	26.80	21.4
	10	25.2	27.6	23.3
	15	21.10	24.9	19.2



Graph 4.2 Compressive Strength of FRC at 7 days where % of MDP used as an Admixture

Table 4.8 Comparison of all Test Results (N/mm²)

S/ No	COMPARISION	USING MARBLE POWDER IN CONCRETE	WASTE MARBLE RATIO	TEST RESULT AFTER CURING		OTHER CONSTITUENTS
				7 DAYS	28 DAYS	
1	Conventional Concrete Mix	As Binder Replacement (Cement)	0%	16.64	18.35	Fine Aggregate/Coarse Aggregate
			5%	1830	24.73	
			10%	20.36	25.50	
			15%	16.80	18.73	
2	Conventional Concrete	As an Admixture	0%	16.64	18.35	Cement/Coarse Aggregate/Fine Aggregate/ Admixture (Marble Powder)
			5%	18.58	25.83	
			10%	20.88	26.95	
			15%	17.90	20.20	
3	Fibre Reinforced Concrete (Recron Fibre)	As an Admixture	0%	19.4	22.3	Fine Aggregate/Coarse Aggregate/Recron Fibre (1%) of Weight of Cement
			5%	20.6	23.5	
			10%	21.8	25.2	
			15%	19.01	21.10	
4	Fibre Reinforced Concrete (Recron Fibre)	As an Admixture	0%	20.9	25.11	Fine Aggregate/Coarse Aggregate/Recron Fibre (2%) of Weight of Cement
			5%	21.86	26.80	
			10%	22.02	27.6	
			15%	20.20	24.9	
5	Fibre Reinforced Concrete (Recron Fibre)	As an Admixture	0%	16.80	18.35	Fine Aggregate/Coarse Aggregate/Recron Fibre (3%) of Weight of Cement
			5%	18.2	21.4	
			10%	19.8	23.3	
			15%	17.1	19.2	



Graph 4.3 compressive strength of conventional concrete, traditional concretes with an admixture and FRC with different % of Recron Fibres (1%, 2% & 3%)

4.2. DISCUSSION

Compressive strength and workability of concretes has been tested at various percentage of marble dust powder in concrete. The percentages of marble dust powder are used in concrete at different categories such as MDP used as a binder replacement (cement), used as an admixture in conventional concrete at various percentage and used as an admixture in fibre reinforced concrete at various percentage where Recron fibre is used. The strength of concrete cubes was tested on 7 days and 28 days curing. The compressive strength test after 7 days and 28 days has been conducted to check out the gain in initial strength of concrete and final strength of concrete respectively. For testing the compressive strength test on concrete the compression testing machine is used. At the time of testing, the cube is taken out from the water and dried up and then tested keeping the smooth faces in upper and lower part.

The following points are obtained from this project-

A. The strength of concretes is increases gradually and then gradually decreased.
B. The initial strength gain in concretes is high as inclusion of marble dust powder till 10%.
C. At 10% replacement of cement with marble dust powder, achieve the maximum compressive strength of 18.30 N/mm^2 and 24.73 N/mm^2 after 7 & 28 days respectively. And then replacing extra percentage of cement strength is start to decreases.
D. At 10% inclusion of marble dust powder as an admixture, there is also achieve maximum compressive strength of 18.58 N/mm^2 and 25.83 N/mm^2 after 7 & 28days respectively.
E. At 10% inclusion of marble dust powder as an admixture in fibre reinforced concrete where 2% of Recron fibre is used, is achieve highest compressive strength of 21.86 N/mm^2 & 26.80 N/mm^2 after 7 and 28 days respectively. And after than adding extra percentage of recron fibre such as 3% and 15 % inclusion of marble dust powder the initial compressive strength is gradually decreases.

5. CONCLUSIONS

A. If percentage of cement replaced with marble dust power is more than 10%, than the compressive strength on concrete will start to decrease. it is showing in the graph that the compressive strength of concrete is increased by replacement of cement with marble dust powder up to 10%, and after than adding extra percentage of marble dust powder by replacement of cement, the compressive strength of concrete is start to decrease.
B. According to this study, the replacement of cement up to 10% with marble dust powder in M-20 grade of cement concrete cube the compressive strength of the cubes increased and then further increase the replacement of cement with marble dust powder there was decrease the strength.
C. If residual marble dust is used in conventional concretes up to 10% of weightage of cement as an admixture, concretes achieve highly compressive strength, and after than start to decrease.
D. If Recron Fibre is used in concrete up to 2% of weight of cement, the compressive strength is maximum at 10% addition of marble dust powder, and after than adding extra percentage of fibre and MDP strength is starts to decrease.
E. Put the forth simple step for minimizing the construction cost with the uses of marble powder which is cheaply and freely available.
F. We can also stop the environmental pollution by cement production which is the main ingredient in the construction of civil engineering field.

6. RECOMMENDATION FOR FUTURE WORK

This project was mainly focused on the partial replacement of Portland slag cement with MDP at different percentage in concrete. Other properties of these concrete should be tested and research carried out on this area, and MDP can be used as a building material in future in greater extent so that the construction industry quality can be better. Some other researches listed below which include the study with MDP;

1. MDP in concrete used as acoustic construction building material.
2. On MDP concrete structures chemical attacks can be tested.
3. In underwater structures the durability of MDP concretes.
4. As a low cost building material effect of earthquake on MDP concrete.
5. To make higher grade of concrete with using plasticizer on MDP concrete.
6. Research on MDP concretes varying the water-cement ratio.
7. Even the study of usage of MDP in concrete production is evaluated; thus, further examinations are needed on the case of durability of concrete mass manufactured by MDP blended binder cements.
8. More researches can do to determine the deflection and durability of concrete that includes MDP.
9. Further report in the seepage properties of the MDP concrete.
10. After some times the flexural strength of beam can be observed by increasing the sizes of beams.
11. The characteristics strengths of concrete mass can be examined with control mix of MDP & glass powder.
12. To study the behavior of MDP concrete under biaxial and multiaxial stresses.
13. To study the factors affecting dry shrinkage and creep of MDP concrete.

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