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EXPERIMENTAL INVESTIGATION ON CONCRETE USING WASTE MARBLE POWDER BY REPLACEMENT METHOD

N.Santhosh Kumar[1]C.Manimegalai[2] M.Reshma[3] U.Suvathy[4] B.Yamuna[5]
[1]Assistant professor, Department of Civil Engineering, Vivekanandha College of Technology for Women, Trichengode.
[2,3,4,5]UG student, Department of Civil Engineering, Vivekanandha college of Technology for Women, Trichengode.

santhoshjagan16@gmail.com

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ABSTRACT
Marble dust powder is obtained by sawing and shaping process in the industries in our region and also marble wastes are generated from the construction site and it causes some environmental issues. In the construction site, the cement usage is increasing rapidly and the cost of cement is incraesing nowadays. In order to reduce the cost of cement and to reduce the waste generated from the marble industry, the marble dust powder are used in concrete by partial replacement of cement. In this project work, the addition of marble dust powder with various proportions (0%, 5%, 10%, 15%) in M25 grade concrete. The series of tests conducted are compressive strength test, split tensile test, flexural strength test in replaced concrete and compared the strengthwith the conventional concrete.

1. INTRODUCTION

Concrete is a broadly utilized crucial material in the development world. Delivering concrete in enormous sum in production lines straight forwardly impacts the greenhouse gases discharges. Decrease in getting great quality construct structures that will solid, strong and delicate to environment. MDP is result gotten amid the quarrying limestone straight forwardly influence the creation of good quality cement higher cement substains of higher strength concrete fundamentally influences the strength at the solidified state because of shrinkage and greater evaluations of heat of hydration. The cost of development likewise gets heightened and further more leaving the waste materials to nature

Mixed concrete in light of the incomplete substitution of Portland cement clinker (PC) by wastage have been the subject of numerous investigation as of late. The progression of concrete technology can diminish the utilization of natural resources and energy sources decrease the weight of contaminations on environment. The utilization of substitution material offer cost lessening, energy saving, apparently predominant items and less dangers in the environment.

2. MARBLE DUST POWDER (MDP)

One of this real waste created in the stone industries amid cutting, forming and cleaning of marbles is the MDP. Amid this procedure around 20-25% of the procedure marble is transformed into powder. India being the third (around %) top most exporter of marble on the planet, consistently million tons of marble waste frame preparing plants are discharged because of the accessibility of extensive amount of waste delivered in the marble industrial facility.

Figure 1 Marble Dust Powder

3. OBJECTIVE AND SCOPE OF REVIEW

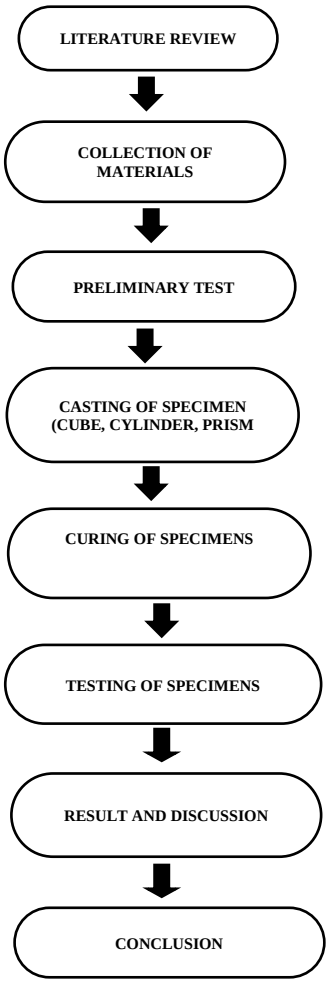
OBJECTIVE

- To determine the compressive, flexural and split tensile strength of concrete by adding marble dust powder in concrete with various proportions.
- To compare the strength behaviour with conventional concrete.

SCOPE

- The marble dust powder are more economical when compared to cement.
- The attainability of marble dust powder in future is abundant.
- The strength and durability of the replaced concrete is increased.

4. METHODOLOGY



5. PRELIMINARY TESTS

- **SPECIFIC GRAVITY TEST:**

S.NO	MATERIALS	SPECIFIC GRAVITY
1	Cement	2.92
2	M Sand	2.68
3	Coarse Aggregate	2.5
4	Marble dust powder	2.62

- **WATER ABSORPTION TEST:**

S.NO	MATERIALS	WATER ABSORPTION IN %
1	M Sand	1.3
2	Coarse Aggregate	0.5

- **FINENESS MODULUS TEST:**

S.NO	MATERIALS	FINENESS MODULUS IN %
1	M Sand	3.75
2	Coarse Aggregate	5.87

- **IMPACT VALUE:**

S.NO	MATERIALS	IMPACT VALUE IN %
1	M Sand	-
2	Coarse Aggregate	13.76

6. FRESH CONCRETE TEST

- **SLUMP CONE TEST:**

Slump cone test –true slump

7. HARDENED CONCRETE TEST

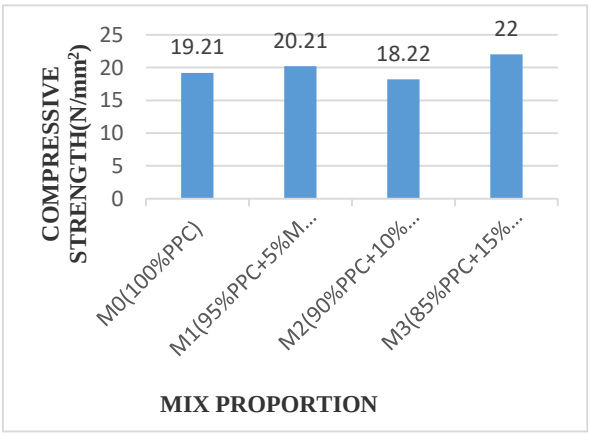
- **COMPRESSIVE STRENGTH TEST:**

$$F_{cu}=\frac{P}{A}$$

Figure 2 Compressive strength test

Table 1. Compressive strength of the cube for 7 days

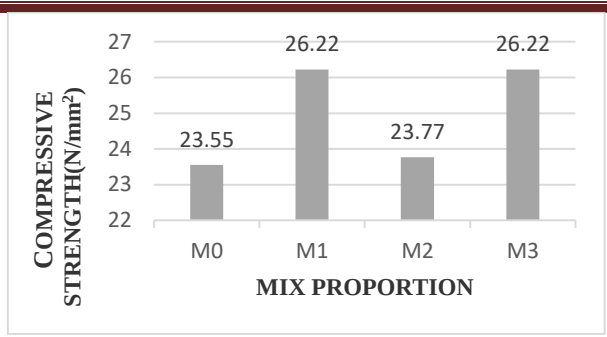
MIX PROPORTION	CURING PERIOD (7 DAYS)	COMPRESSIVE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE (N/mm^2)
M_0	Sample 1	415	18.44	19.21
	Sample 2	420	18.66	
	Sample 3	425	19.21	
M_1	Sample 1	450	20.21	20.21
	Sample 2	445	19.77	
	Sample 3	440	19.55	
M_2	Sample 1	390	17.33	18.22
	Sample 2	395	17.55	
	Sample 3	410	18.22	
M_3	Sample 1	470	20.88	22.00
	Sample 2	490	21.77	
	Sample 3	495	22.00	



Graph1. Compressive strength of the cube for 7 days

Table 2. Compressive strength of the cube for 14 days

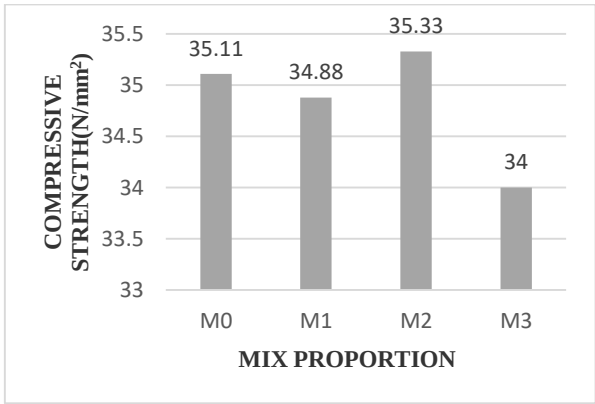
MIX PROPORTION	CURING PERIOD (14 DAYS)	COMPRESSIVE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE (N/mm^2)
M_0	Sample 1	520	23.11	23.55
	Sample 2	525	23.33	
	Sample 3	530	23.55	
M_1	Sample 1	570	25.33	26.22
	Sample 2	575	25.55	
	Sample 3	590	26.22	
M_2	Sample 1	495	22.00	23.77
	Sample 2	510	22.66	
	Sample 3	535	23.77	
M_3	Sample 1	550	24.44	26.22
	Sample 2	570	25.33	
	Sample 3	590	26.22	



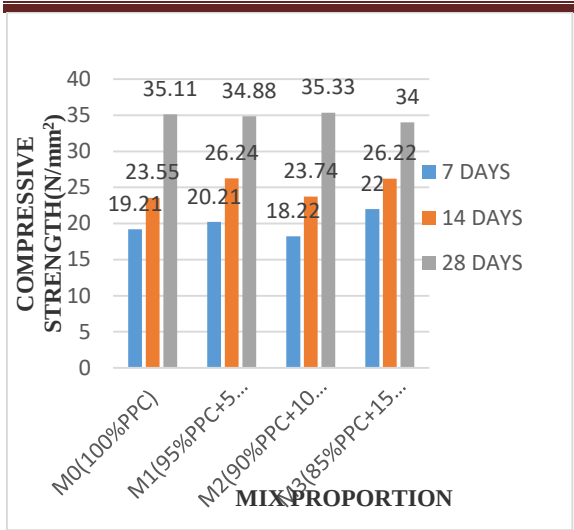
Graph2. Compressive strength of the cube for 14 days

Table 3. Compressive strength of the cube for 28 days

MIX PROPORTION	CURING PERIOD (28 DAYS)	COMPRESSIVE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE(N/mm^2)
M_0	Sample 1	750	33.33	35.11
	Sample 2	775	34.44	
	Sample 3	790	35.11	
M_1	Sample 1	755	33.55	34.88
	Sample 2	770	34.22	
	Sample 3	785	34.88	
M_2	Sample 1	760	33.77	35.33
	Sample 2	775	34.44	
	Sample 3	795	35.33	
M_3	Sample 1	745	33.11	34
	Sample 2	755	33.55	
	Sample 3	765	34	



Graph 3. Compressive strength of the cube for 28 days



Graph 4. Comparison of compressive strength at 7, 14, 28 days in N/mm²

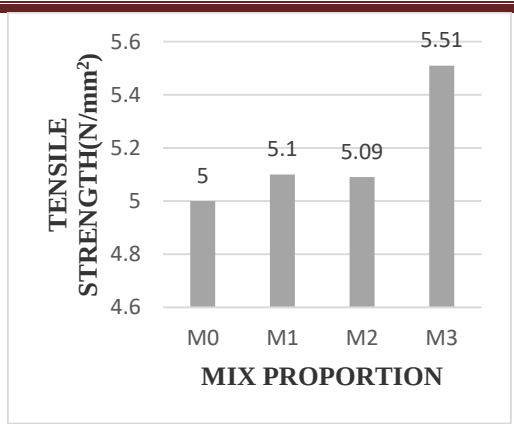
- **SPLIT TENSILE STRENGTH TEST**

Split tensile test = $\frac{2P}{\pi LD}$

Figure 3 split tensile strength test

Table 4. Split tensile test of the cylinder for 7 days

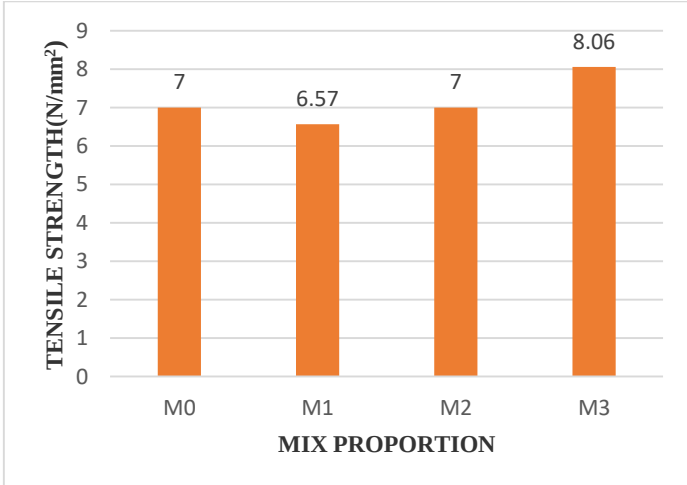
MIX PROPORTION	CURING PERIOD (7 DAYS)	COMPRESSIVE LOAD (KN)	TENSILE STRENGTH (N/mm²)	AVERAGE (N/mm²)
M_0	Sample 1	320	4.52	5.0
	Sample 2	335	4.7	
	Sample 3	355	5.0	
M_1	Sample 1	340	4.8	6.5
	Sample 2	460	6.5	
	Sample 3	365	5.1	
M_2	Sample 1	345	4.88	5.09
	Sample 2	355	5.0	
	Sample 3	360	5.09	
M_3	Sample 1	370	5.23	5.51
	Sample 2	385	5.4	
	Sample 3	390	5.51	



Graph 5. Split tensile test of the cylinder for 7 day

Table 5. Split tensile test of the cylinder for 14 days

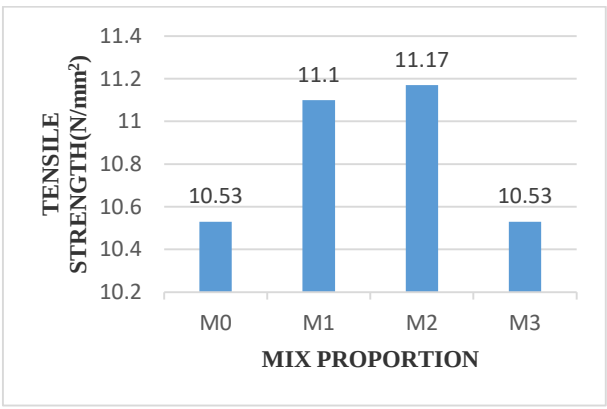
MIX PROPORTION	CURING PERIOD (14 DAYS)	COMPRESSIVE LOAD (KN)	TENSILE STRENGTH (N/mm²)	AVERAGE (N/mm²)
M_0	Sample 1	490	6.9	7.0
	Sample 2	495	7.0	
	Sample 3	480	6.79	
M_1	Sample 1	475	6.71	6.71
	Sample 2	465	6.57	
	Sample 3	460	6.50	
M_2	Sample 1	485	6.86	7.14
	Sample 2	495	7.00	
	Sample 3	505	7.14	
M_3	Sample 1	455	6.43	8.06
	Sample 2	570	8.06	
	Sample 3	465	6.57	



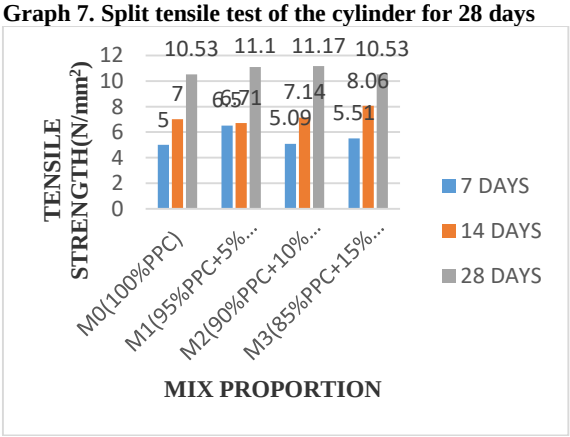
Graph 6. Split tensile test of the cylinder for 14 days

Table 6. Split tensile test of the cylinder for 28 days

MIX PROPORTION	CURING PERIOD (28 DAYS)	COMPRESSIVE LOAD (KN)	TENSILE STRENGTH (N/mm^2)	AVERAGE(N/mm^2)
M_0	Sample 1	720	10.18	10.53
	Sample 2	750	10.6	
	Sample 3	745	10.53	
M_1	Sample 1	770	10.89	11.10
	Sample 2	775	10.96	
	Sample 3	785	11.10	
M_2	Sample 1	790	11.17	11.17
	Sample 2	770	10.89	
	Sample 3	785	11.10	
M_3	Sample 1	735	10.39	10.53
	Sample 2	720	10.18	
	Sample 3	745	10.53	



Graph 7. Split tensile test of the cylinder for 28 days



Graph 8. Comparison of split tensile strength at 7, 14, 28 days

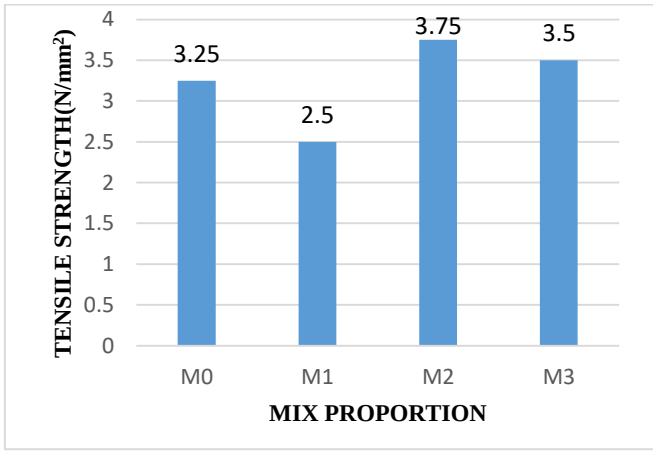
- **FLEXURAL STRENGTH TEST**

$$\text{Flexural strength test} = \frac{PL}{bd^2}$$

Figure 4 Flexural strength test

Table 7. Flexural strength of the prism for 7 days

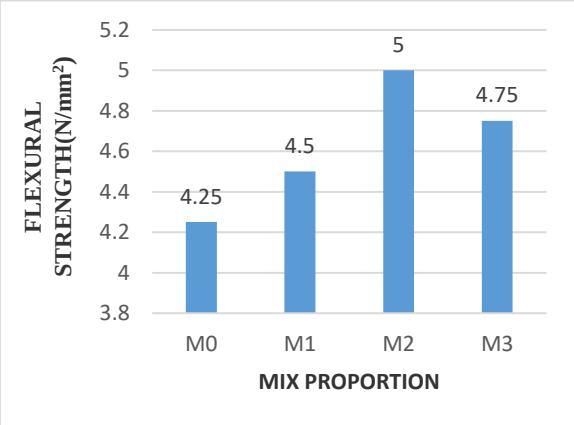
MIX PROPORTION	CURING PERIOD (7 DAYS)	COMPRESSIVE LOAD (KN)	FLEXURAL STRENGTH (N/mm^2)	AVERAGE (N/mm^2)
M_0	Sample 1	5.0	2.50	3.25
	Sample 2	6.5	3.25	
	Sample 3	5.5	2.75	
M_1	Sample 1	4.5	2.25	2.50
	Sample 2	5.0	2.50	
	Sample 3	6.0	2.00	
M_2	Sample 1	7.0	3.50	3.75
	Sample 2	7.5	3.75	
	Sample 3	6.0	2.00	
M_3	Sample 1	5.5	2.75	3.50
	Sample 2	6.5	3.25	
	Sample 3	7.0	3.50	



Graph 9. Flexural strength test of the prism for 7 days

Table 8. Flexural strength of the prism for 14 days

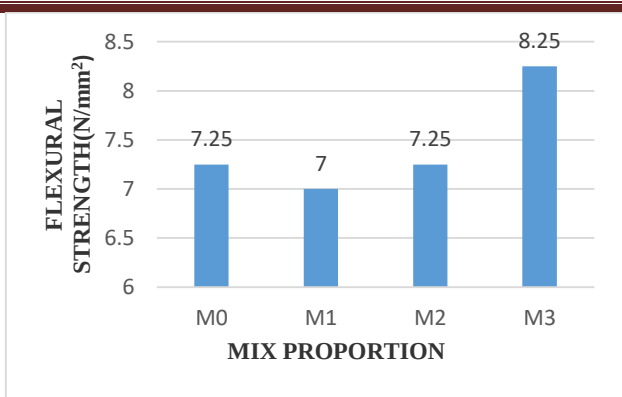
MIX PROPORTION	CURING PERIOD (14 DAYS)	COMPRESSIVE LOAD (KN)	TENSILE STRENGTH (N/mm^2)	AVERAGE (N/mm^2)
M_0	Sample 1	8.5	4.25	4.25
	Sample 2	7	3.5	
	Sample 3	8	4	
M_1	Sample 1	7	3.5	4.5
	Sample 2	7.5	3.75	
	Sample 3	9	4.5	
M_2	Sample 1	10	5	5
	Sample 2	8.5	4.25	
	Sample 3	7	3.5	
M_3	Sample 1	9.5	4.75	4.75
	Sample 2	8	4	
	Sample 3	8.5	4.25	



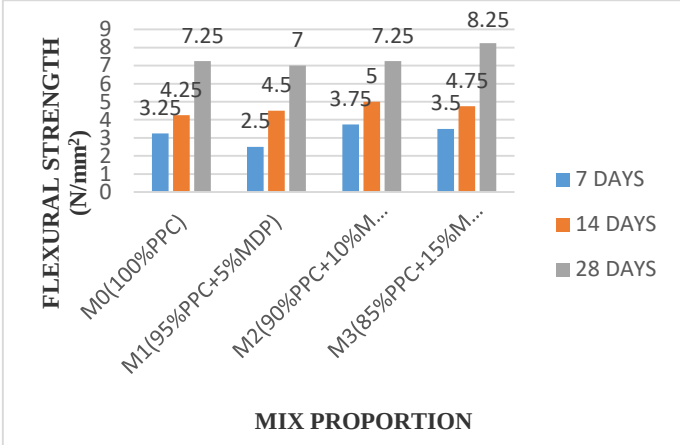
Graph 10. Flexural strength test of the prism for 14 days

Table 9. Flexural strength of the prism for 28 days

MIX PROPORTION	CURING PERIOD (28 DAYS)	COMPRESSIVE LOAD (KN)	FLEXURAL STRENGTH (N/mm^2)	AVERAGE(N/mm^2)
M_0	Sample 1	10.5	5.25	7.25
	Sample 2	12	6.00	
	Sample 3	14.5	7.25	
M_1	Sample 1	11.5	5.75	7.00
	Sample 2	12.5	6.25	
	Sample 3	14	7.00	
M_2	Sample 1	10	5.00	7.25
	Sample 2	12	6.00	
	Sample 3	14.5	7.25	
M_3	Sample 1	15	7.50	8.25
	Sample 2	16.5	8.25	
	Sample 3	13.5	6.75	



Graph 11. Flexural strength test of the prism for 28 days



Graph 12. Comparison of flexural strength at 7, 14, 28 days

6. CONCLUSION

Based on the literature Based on literature review, following conclusions are obtained:

- Use of marble as a substitute of cement will prove out to be sustainable method of producing concrete.
- Above literature review commits that use of waste marble powder in concrete at its optimum content will surely enhance the strength parameters of the concrete.
- The maximum compressive strength obtained was 14% marble powder replacement for cement.
- Workability of concrete was reduced due to large surface area of waste marble powder.
- Durability parameters of the marble powder showed improvement which makes its suitable as an additive in concrete.
- Extreme value against acid attacks was obtained when cement is replacement with marble dust.
- Standard consistency is found to reduce where as initial and final setting times increase but not very significantly. This is good for proper setting of concrete as initial setting time should be sufficiently long for the transportation and placing of concrete
- The compressive strength of the concrete increases by **15% replacement of cement by marble dust powder.**

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