International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF CEMENT WITH MARBLE DUST POWDER AND ADDITION OF POLYCARBOXYLATE ETHER IN PERVIOUS CONCRETE

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Abstract - *Pervious Concrete is a high porous concrete that allows water from precipitation and other sources to pass through resulting in reduction of runoff from a site and do recharge the ground water level. Pervious concrete has little or no fine aggregate and has just enough cementitious paste to coat the coarse aggregate particles while preserving the interconnectivity of the voids. It is a promising sustainable material now a day for parking lots, areas with light traffic, pedestrian walkway and greenhouses and contribute to sustainable construction. Marble Dust Powder (MDP) is a developing composite material and is a by-product obtained during the quarrying process from the parent marble rock. Polycarboxylate are linear polymers with a high molecular mass and with many carboxylate groups. Polycarboxylate Ether (PCE) is used as super plasticizers in concrete production. They are known for reducing water content and imparting high strength concrete. It contains high calcium oxide content i.e., more than 50%, also the reactivity efficiency increases due to the presence of lime. In this project cement in pervious concrete is partially replaced with Marble Dust Powder (MDP) with different proportion varying 0%, 5%, 10%, and 20% on the basis of weight and super plasticizer Polycarboxylate Ether (PCE) is also added to the mix at proportion of 2%, 4%, 6% and 8% respectively. And the mechanical properties like Compressive strength, Flexural strength and Split tensile strength are evaluated at 7 and 28 days.*

***Key Words*: Pervious concrete, Marble Dust Powder (MDP), Super plasticizer, Partial Replacement, Compressive strength, Flexural strength, Tensile strength, Polycarboxylate Ether (PCE).**

1. INTRODUCTION

Pervious concrete is nothing but no fine aggregate in this type of concrete, it is used for concrete flatworks that allows water to pass directly through it and reduce the runoff from the site. Pervious concrete mainly used in parking areas, parking lots, residential streets, pedestrian walkways and green houses. Pervious concrete is made using the aggregate of size which passing through 12 mm and retained on 10 mm sieve. In this research pervious concrete is made by partially replacing cement with marble dust powder and polycarboxylate ether is added as super plasticizer.

1.1 Marble Dust Powder

Marble dust is a waste material formed during the production of marble. Marble is a metamorphic rock it is formed from the transformation of a pure limestone. Lime stone is composed of calcium. Presently large amounts of marble dust are generated in natural stone processing plants which make many problems to environment and human. Many research works are carried out to determine the effectiveness of using marble dust as replacement material in concrete.

1.2 Polycarboxylate Ether

Polycarboxylate ether is used as super plasticizer which imparts high workability and high strength to the concrete. It reduces the w/c ratio of the mix.

2. LITERATURE SURVEY

Arun Kumar et al (2018), conducted a study to determine the strength behavior of concrete produced with Marble Dust Powder. Study is conducted by 0%, 7.5%, 15%, 22.5%, and 30% by weight. Partial replacement of cement with marble dust powder for making of cement concrete with 0.40 water cement ratio. Compressive strength, split tensile strength and flexural strength of concrete are tested at 1, 28 and 90 days. Test result shows that the strength increases up to 15 % replacement of cement then strength decreases.

Aditya Kumar et al (2016), conducted a to study effect of superplasticizer on concrete. The superplasticizer used here was polycarboxylate ether. It was added to the concrete at 0.2%, 0.4%, 0.6%, 0.8% and 1% etc. it was noted that the use of polycarboxylate ether regulates and improve the fluidity of concrete without affecting the proportion. The strength of the concrete has been increased with the addition of polycarboxylate ether.

3. TEST ON PERVIOUS CONCRETE

From various studies, basic knowledge and experimental study, the composition of pervious concrete for this project is concluded as 1:4 mix ratio. Firstly, we partially replace the

cement by marble dust powder by a percentage of 5%, 10%, 15% and 20% respectively. And various tests like compressive strength, flexural strength and split tensile strength are checked on these specimens to find the best among those specimens.

Fig -1: Compressive Strength Test

Fig -1: Split Tensile Strength Test

Fig -1: Flexural Strength Test

Then the best of the specimen from partially replaced with marble dust powder is taken and the superplasticizer polycarboxylate ether is added at 0.2%, 0.4%, 0.6% and 0.8% respectively. And these specimens are again subjected under the strength tests to find out the best specimen.

Table -1: Specification of specimens

Mix identity	Mix Proportion
A1	95% Cement + 5% MDP
A2	90% Cement + 10% MDP
A3	85% Cement +15 % MDP
A4	80 % Cement + 20% MDP
B1	85% Cement +15 % MDP + 0.2% PCE
B2	85% Cement +15 % MDP + 0.4% PCE
B3	85% Cement +15 % MDP + 0.6% PCE
B4	85% Cement +15 % MDP + 0.8% PCE

4. RESULTS AND DISCUSSIONS

Specimens of pervious concrete by replacing cement with marble dust powder (at 5%, 10%, 15% and 20%) and addition of superplasticizer polycarboxylate ether (at 0.2%, 0.4%, 0.6% and 0.8%) are obtained. These specimens are tested for strength tests like compressive strength test, split tensile strength test and flexural strength test. The test result for 7th day and 28th day is taken. The test is mainly conducted in two phases. Firstly, with the marble dust powder by replacing cement and secondly with the addition of super plasticizer polycarboxylate ether. The results are obtained as follows:

Table – 2: Compressive Strength of Specimens

Mix identity	Compressive strength (N/ mm^2)	
	7th Day	28th Day
A1	18.5	21.4
A2	18.9	22.1
A3	19.8	23.5
A4	19.1	22.7
B1	19.8	23.8
B2	20.1	24.6
B3	20.5	25.4
B4	19.9	24.2

Table –3: Split Tensile Strength of Specimens

Mix identity	Split tensile strength (N/ mm²)	
	7th Day	28th Day
A1	1.42	2.18
A2	1.49	2.32
A3	1.56	2.45
A4	1.50	2.25
B1	1.56	2.44
B2	1.61	2.86
B3	1.72	3.32
B4	1.63	3.04

Table –4: Flexural Strength of Specimens

Mix identity	Flexural strength (N/ mm²)	
	7th Day	28th Day
A1	3.8	5.8
A2	3.9	6.5
A3	4.2	7.7
A4	3.9	6.3
B1	4.3	7.8
B2	4.9	8.1
B3	5.2	8.8
B4	4.8	8.2

From the results in tables 2, 3 and 4 we can conclude to a result that from the experiment of replacing cement with marble dust powder the specimen A3 has given the top result in compressive strength, split tensile strength and flexural strength. Then the further experiment on specimen A3 with addition of superplasticizer polycarboxylate ether the specimen B3 has given the best results with high compressive strength, split tensile strength and flexural strength.

5. CONCLUSIONS

As per the experimental study carried out in this project we had obtained a positive result. The best result among the specimens of pervious concrete with cement replaced by marble dust powder was obtained for specimen with 85% cement and 15% marble dust powder. Further processing with this specimen with addition of polycarboxylate ether the best result was obtained for specimen with addition of 0.6% polycarboxylate ether. Hence the best specimen had given the compressive strength of 25.4 N/ mm², split tensile strength of 3.32 N/ mm² and flexural strength of 8.8 N/ mm² at 28th day result. So the best specimen had turn out with mix ratio 1:4 and the composition of pervious concrete with 85% cement and 15% replaced marble dust powder and addition of 0.6% superplasticizer polycarboxylate ether.

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