PERFORMANCE OF PERVIOUS CONCRETE MADE WITH BLACK MARBLE STONE AGGREGATE

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ABSTRACT

Normal or conventional concrete, which is a combination of cement, sand, coarse aggregate and water, forms a hard surface. The fast urbanization and infrastructure developments cause compactly constructed buildings. Depletion of ground water is a major problem today due to the lack of percolation of rain water into the soil. The impermeable nature of conventional concrete restricts the flow of rainwater into the ground. Pervious concrete is one solution to this problem. Pervious concrete is also called enhanced porosity concrete, which is used widely nowadays due to its higher infiltrating ability. Pervious concrete is made up of cement paste, coarse aggregate with little or no fine aggregate. The paste binds the aggregate particles together to develop a system of interconnected and highly permeable voids that encourage the quick drainage of water. Generally, it is used in parking areas, areas with light traffic, residential streets, pedestrian roads and drain covers. The proper utilization of pervious concrete is recognized as Best Management Practice by the U.S. Environmental Protection Agency (EPA) for providing storm water management.

Keyword: - *Pervious concrete ,Black Marble Stone waste Aggregate, Compressive Strength*

1. INTRODUCTION-1

Concrete is a composite material consisting of cement, sand, coarse aggregate and water and is the most commonly used material in construction globally. It is a brittle material with higher compressive strength. There has been continuous development in the manufacturing of concrete since the time of invention. Initially, materials like gypsum or limestone were burnt and used as crude cement. Later, these cements are mixed with sand and water to form mortar, which was a binding material used to fix stones to each other.

To improve the strength characteristics in any type of concrete, mineral constituents play a vital role in the ingredients of concrete. Many Works has been carried out to improve the performance of the concrete. To prevent the extinction of natural resources in the environment, the usage of new materials in concrete is also increasing day by day without compromising the required properties of concrete to meet the increasing demand in the industry. Concrete is a hard, impervious material in general.

There are different types of concrete developed from time to time, such as fiber reinforced concrete, self compacting concrete, light weight concrete, high density concrete etc to meet the various applications.

1.1 Application of Pervious Concrete-1

Pervious concrete has limited applications due to lack of durability under heavy loads.

 It is used in areas with light traffic, parking areas, pedestrian highways, in green houses and residential streets.
 Pervious concrete is an important application for green building.
 It is also used as one of the techniques by builders to save water.
 It is used as noise barriers and in retaining walls to prevent logging of water and stabilize the slope.
 This can also be used as a storm water management technique in low traffic areas.

1.2 Benefits of pervious concrete -2

The benefits of pervious concrete are
 By using this concrete, the flow of water on the surfaces can be reduced.
 Requirements for farm ponds, soak pits etc. can be minimized.
 The expenditure incurred on the various rain harvesting techniques can be minimized.
 It increases the ground water table and recharges the nearby bore wells and aquifers.

2. MATERIAL-2

Good quality concrete is obtained by proper portioning of ingredients in concrete mix such as cement, fine and coarse aggregates. The appropriate proportion of materials provides homogenous mixture thus achieves designed strength and serves the service life. The nominal mix designs used for adequate strength are based on the fixed cement - aggregate ratio. This is not suitable for all grades of concrete. The estimation of essential quantities of materials in an optimum and economical way to achieve the target strength of concrete is considered as mix design. From the mix design, the suitable quantities of cement, fine aggregate, coarse aggregates and water are obtained. The mix design further depends on the properties of materials used.

Material properties such as type of material, consistency, specific gravity, size, shape, texture, density, water absorption and gradation or particle size of aggregate greatly influence the mix design. Hence, in this chapter the basic properties of all materials used in the work are studied. By using these material properties a suitable concrete mix was designed and the procedure involved.

The materials used in the experimental investigation include.

1. Cement
2. Coarse aggregate
3. Fine aggregate
4. Water

2.1 Cement-1

The strength of the hardened concrete gets affected, if the consistency of the cement paste is either extremely harsh or wet. Initial experiments like initial setting time, final setting time, specific gravity and compressive strength test on mortar cubes were conducted on cement with regard to various water quality parameters. Ordinary Portland Cement (OPC) 53 grade ACC cement was used in the present investigation corresponding to IS 12269 (1987).

Table -1 Physical Properties of Cement

Physical properties	**Test result**	**Requirement as per IS 12269 (1987)**
Specific gravity	3.15	–
Fineness (m2/Kg)	311.5	Min.225 m2/kg

Normal consistency	30%	–
Initial setting time (min)	90	Min. 30 min
Final setting time (min)	320	Max. 600 min

2.2 Fine Aggregate-2

The fine aggregate (sand) used throughout the experimental work was obtained from the river Pandameru near Anantapur, Andhra Pradesh.The specific particle size composition of the sand was prepared as per the I.S.Code 650-1966 and I.S. Code 383-1970.

Table -2 :- Properties of sand

Sl.No	Property	Unit	Result
1	Specific Gravity	---	2.62
2	Bulk Density	KN/m3	14.50
3	Fineness Modulus	---	2.85
4	Water absorption	%	0.5

2.3 **Coarse Aggregate**

Crushed Granite stone aggregate of maximum size 20 mm, confirming to IS 383-1970 was used. The specific gravity and fineness modulus were found to be 2.7 and 3.28 respectively.

Table 4.4 Grading analysis for coarse aggregate – Sample - 5000gms

SI. NO	I.S.Sieve size	Weight Retained (gms)	Cumulative Weight retained (gms)	Cumulative % retained	% Passing
1	80mm	-	-	-	100.00
2	40mm	-	-	-	100.00
3	20mm	2940.00	2940.00	58.80	41.20
4	10mm	1040.00	3980.00	79.60	20.40
5	6.30mm	530.00	4510.00	90.20	9.80
6	4.75mm	490.00	5000.00	100.00	--
	Total	5000.00		328.6	271.4

Fineness Modulus=328.60/100 = 3.

2.4 **Black Marble Stone Waste Aggregate**

Crushed Black Marble stone waste aggregate of maximum size 20 mm, confirming to IS 383-1970 was used. The specific gravity and fineness modulus were found to be 2.75 and 3.49 respectively. Grading analysis is presented in table 4.6. Different properties of the BMSWA used in this experimental work.

Table 4.6 Grading analysis for BMSWA – Sample - 5000gms

SI. NO	I.S.Sieve Size	Weight Retained (gms)	Cumuulative Weight retained (gms)	Cumulative % retained	% passing
1	80mm	-	-	-	100
2	40mm	-	-	-	100
3	20mm	2930	2930	58.6	42.4
4	10mm	1620	4550	91	9.0
5	6.30mm	450	5000	100	-
6	4.75mm	-	-	100	-
	Total	5000	-	349.6	251.4

Fineness Modulus=349.60/100=3.49

3. MIXING-3

All the required quantities of cement, sand and coarse aggregates weighed separately 43 and mixed in dry condition. The obtained proportion of water is added to the composite mixture and mix thoroughly until a uniform mixture is formed. The same procedure is repeated for different mixes which includes the reduction of fine aggregate in different percentages and replacement of coarse aggregate with black marble stone waste aggregate. The complete mixing is done by hand mixing.

Table 4.12 Slump Values (mm) for different mixes

S.NO	Replacement Natural Aggregate with BMSWA(%)	% Of the fine aggregate reduction in mix					
		0	20	40	60	80	100
1	0	58	60	63	65	73	80
2	50	62	64	67	68	80	92
3	100	70	72	77	77	85	102

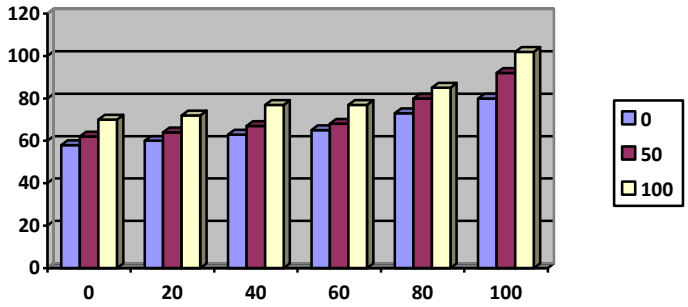


Chart -1: Slump Values Vs. % reduction in fine aggregate

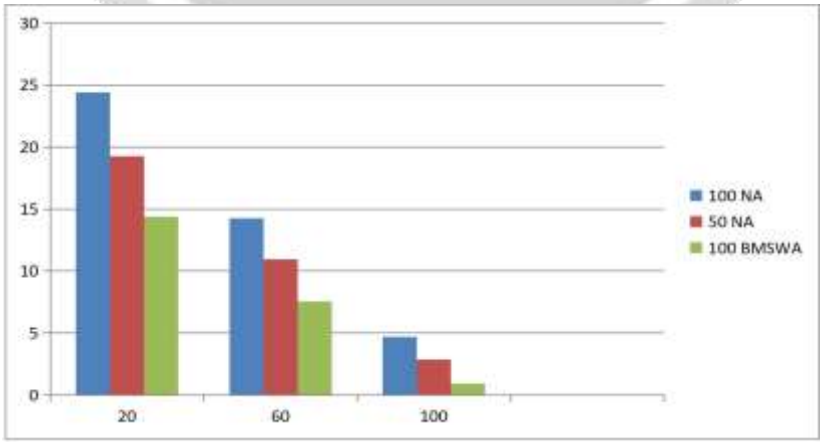
3.1 **Compressive strength test (IS 516-1989)**

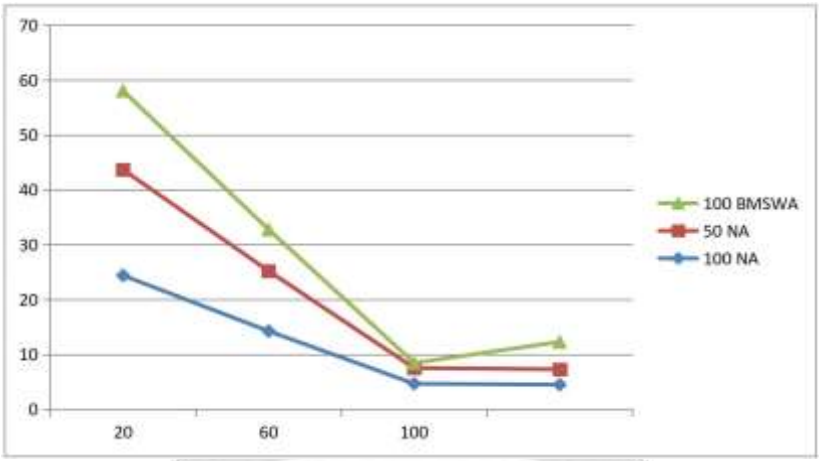
Compressive strength of concrete is the most important characteristic and it is an indexing property as concrete is designed to carry compressive loads.

Table 5.3 28 days Compressive Strength

Sr. No.	Replacement of Natural Aggregate with BMSWA(%)	Compressive strength(Mpa)		
		% of fine aggregate reduction in mix		
		20	60	100
1.	0	24.4	14.26	4.69
2.	50	19.28	10.96	2.86
3.	100	14.37	7.54	0.93

% Reduction in fine aggregate





4. CONCLUSIONS

The main objective of this investigation is to study the performance of the Pervious concrete made with reduction of fine aggregates (Sand) and replacement of the natural aggregate with BMSWA at 0, 50 and 100%. The performance is studied with respect to the mechanical properties namely compression test.

1. The workability of the Pervious concrete is increased for replacement natural aggregate with BMSWA may be due to smooth surface of the aggregate. Also as the percentage reduction of fine aggregates increase the workability increased due to higher cement paste available in the mix.

2. The compressive strengths were decreased with increase of percentage replacement of BMSWA in the concrete mix. This decrease in strength may be due to less aggregate crushing strength as well as less aggregate impact value.

3. The compressive strengths of the concrete for 100% natural aggregate and reduction of the fine aggregate from 0 to 100% varies from 28.44MPa to4.69 MPa. For 50% natural aggregate the strengths are 23.11MPa to 2.86MPa and for 100% BMSWA the strengths are 18.11MPa to 0.93 MPa. It is observed that the compressive strengths are decreased due to the formation of voids with the percentage reduction of the fine aggregate. It is also observed that there is decrease in compressive strength of the concrete when the natural aggregate is replaced with BMSWA.

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