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Comparison of 7 Days, 14 Days & 28 Days Cube Crushing Strength of Thirsty Concrete using Different Types of Coarse Aggregate & Waste Material (Recycled Aggregate) as Coarse Aggregate

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Abstract *– To overcome the problem of water logging due to impermeability of floors and pavement, the pervious concrete is the best solution that increases the better understanding of linkage between microstructure, transport properties and durability will assist in mix proportion and design. There are two major issue while working with Pervious concrete. First is the strength of pervious concrete is very weak due to absence of fine aggregate and other is the high demand for natural construction material. This paper, Represent about the materials, properties, construction & Design Mix of pervious concrete and provide a details about the limitations and future scope of the usage of pervious concrete in India. The experimental work deals with the effect of different types of coarse aggregate in strength.*

A total numbers of 45 specimens were cast with 20 mm size & other 45 specimen cast with 12 mm size aggregate of angular, flaky, rounded, broken marbles and recycled aggregate cured and tested for compressive strength. The specimens were cast without adding any fine aggregate with the mix proportion 1: 4.38 (cement: aggregate) and by adding 10% fine aggregate with the mix proportion 1:0.438:3.95 (cement: sand :aggregate). This research is total of two different mixes of various shape and materials were used such as without and with fine aggregates, two different coarse aggregates, of size 12mm and 20mm. The experiment has been done in this project has considered 7 days, 14days and 28 days compressive strength of pervious concrete. The mix M2 with river sand as Normal River sand and crusher stone sand and 12mm coarse aggregate has shown superior performance in terms of higher compressive strength than mixM1.

Keywords- *Angular, Flaky, Rounded, Broken Marble and Recycled Aggregate, Pervious Concrete, Sand.*

I- INTRODUCTION

Every city has its unique challenges. In the cities which are situated near the sea like Chennai, Kolkata and Mumbai if there are heavy rainfalls happens during high tide, then the tide causes the water to wash back into the city, and it is not absorbed by the surface that leading to water logging. A lack of state-of-the-art rain forecasting system could have been a factor in water logging earlier but India recently updated its weather tech and the blame for water logging now squarely lies

on the unpreparedness of the state municipal corporations.

Adding to manmade problems are natural reasons for this problem getting worse each year. As the health of countries worsens, the health of its states & cities worsen too. The absorbing of Water such as wastelands, saltpans, wetlands and mangroves of our country are shrinking due to reestablishments of land uses for development – this leaves more and more storm water to be dealt with by civic authorities who are already burdened with a multitude of problems.

Pervious concrete is known as the special type of concrete that have high voids which increases it's permeability applied for concrete work & flatwork applications that permits water from weather action like precipitation, raining and other sources to travel through it, which minimizing the runoff from the effected site and can recharging ground water levels. Typically thirsty concrete has no fine aggregate or has little fine aggregate and has just appropriate cementious paste to overcoat the coarse aggregate particles while conserving the inter-relativity of the pores.

Background History of Pervious Concrete:- Pervious concrete was first applied in 1800 in Europe as pavement material for surface covering and structure of load bearing. The initial use of pervious concrete was made in the Britain in near to 1850 with the construction of two houses of residential and a seawall. The pervious concrete is applied initially in 1852 (Ghafoori and Dutta). Although not a new technology, pervious concrete is achieving renewed interest in the America, partly cause of FCWL(Federal Clean Water Legislation). The (USEPA)Environmental Protection Agency's Phase II requires the Final Rule to operators of all municipalities in urban areas to develop, execute, and impose a program to minimize pollution particles in post-construction runoff from redevelopment and new growth projects that outcome in disturbance of land of greater than or equal to 1 acre.

Pervious concrete is a highly porous type of concrete which is light in weight and it is obtained by reducing, replacing or withdrawing the fine aggregate from the conventional concrete. The ingrained properties of the thirsty concrete is low cost due to less cement content, low bulk density, low conductivity of temperature and drying shrinkage, less segregation and high porous movement of water. Due to the availability of large voids, this concrete is applied as a permeable material. Pervious concrete does not represent the sufficient strength of compression due to pervious material with conventional shape and size though it need to prevent storm water runoff from initiating flood and downstream abrasion. Pervious concrete is basically used in parking areas wherethe traffic is light, pedestrian walkways, foot-path, and greenhouses. Pervious concrete is an improved implementation for sustainable construction of structure.

This experimental work is carried out to enhance the strength of compression of thirsty concrete with alternate shape and size of aggregate with little percentage of fine aggregate say 10%.

II- Material Used

The Portland cement is used as binding material, Tap water, Crushed quarry rocks and river sands as other ingredients. Crushed coconut shells are used as replacement for coarse aggregates, their description is as follows

A. Cement
   Powdery form and manufactured by calcareous material like clay and lime, siliceous and argillaceous material, act as the binding material when mixed with water.
   Test were conducted on cement and the results are presented in Table 1.

B. Fine aggregate
   Sand which is accumulated of granular material or particles in rounded form was used as fine aggregate in MIX2 number of test were conducted to determine the properties of natural sand shown in Table 2

C. Coarse aggregates
   The aggregate of various size & shapes were including recycled coarse aggregates were used in as two categories mixed of 12 mm & upto 20 mm size nominal aggregate. Indian Standard was followed to while testing materials. The test results are presented in Table 3.

Table.1 Properties of cement

Name of the Test	**Experimental Results**	**Std values as per IS 12269 -1989 (R A 2008)**
Fineness Test	6%	Shall not be more than 10%
Consistency	32.20%	Not Specified
Initial Setting Time	35 minutes	Shall not be less than 30 minutes
Final Setting Time	245 minutes	Shall not be more than 600 minutes
Sp. Gravity of Cement	3.15	Not Specified

Table.2 Properties of sand

Name of the Test	**Experimental Results**	**Std values as per 383 - 1970 (R A 2007)**
Sp. Gravity of sand	2.65	Not Specified
Water Absorption	3%	Not Specified

Table.3 Properties of coarse aggregate

Test Conducted	**Result**		**Std values as per IS 383-1970 (RA 2007)**
	Aggregate Size		
	20mm	**12mm**	
Sp. Gravity	**2.7**	**2.65**	Not Specified
Water Absorption	**0.84%**	**2.50%**	Not Specified
Crushing Value	**17**	**19**	**Shall not exceed 45%**
Flakiness Index	**36.2**	**29**	**Shall not exceed 35%-40% as per SP23**
Flakiness Index	**46.2**	**40**	**Shall not exceed 45%-50% as per SP23**

III-METHODOLOGY

The raw materials used in this experimentation were locally available and these included most common binding agent as OPC, fine aggregates is sand procured locally and crushed shale stones and coconut sh ell. Tap water is used for mixing and curing as it is easily available. The material used for coarse aggregate will be having minimum particle size of 4.75mm. Do a thorough cleaning to remove clay particles. The Methodology used in this study is depicted below:

3.1 Selection of materials:

1. Cement
2. Fine aggregate
3. Coarse aggregate(Stone quarry)
4. Coconut shell

3.2 Tests on materials:

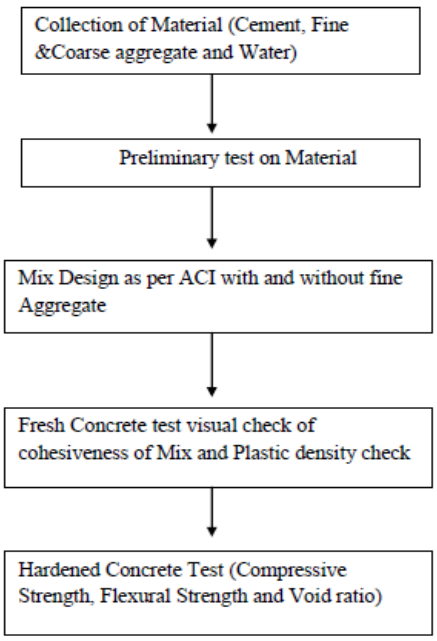


Chart 3.1- Flow chart of methodology

Table 4: Tests on materials

S. No	Material	Test	Apparatus
1.	Cement	Specific Gravity	Le-Chatelier flask
		Standard Consistency	Vicat's apparatus
		Initial and Final Setting Time	Vicat's apparatus
		Fineness Test	Sieve shaker
2	Fine aggregate	Sieve Analysis of fine aggregate	Sieve shaker
		Water Absorption	
3	Coarse Aggregate	Specific gravity	Wire Basket
		Water Absorption	
		Aggregate impact test	Impact testing machine
		Aggregate crushing value	Compression testing machine
		Flaky ness index	Flaky ness gauge
		Elongation index	Elongation gauge
		Abrasion Value	Los angelus

3.3 Mix Proportions:

A total numbers of 45 specimens were cast with 20 mm size & other 45 specimen cast with 12 mm size aggregate of angular, flaky, rounded, broken marbles and recycled aggregate cured and tested for compressive strength. The specimens were cast without adding any fine aggregate with the mix proportion 1: 4.38 (cement: aggregate) and by adding 10% fine aggregate with the mix proportion 1:0.438:3.95 (cement: sand :aggregate). This research is total of two different mixes of various shape and materials were used such as without and with fine aggregates, two different coarse aggregates, of size 12mm and 20mm. The experiment has been done in this project has considered 7 days, 14days and 28 days compressive strength of pervious concrete.

IV- RESULTS

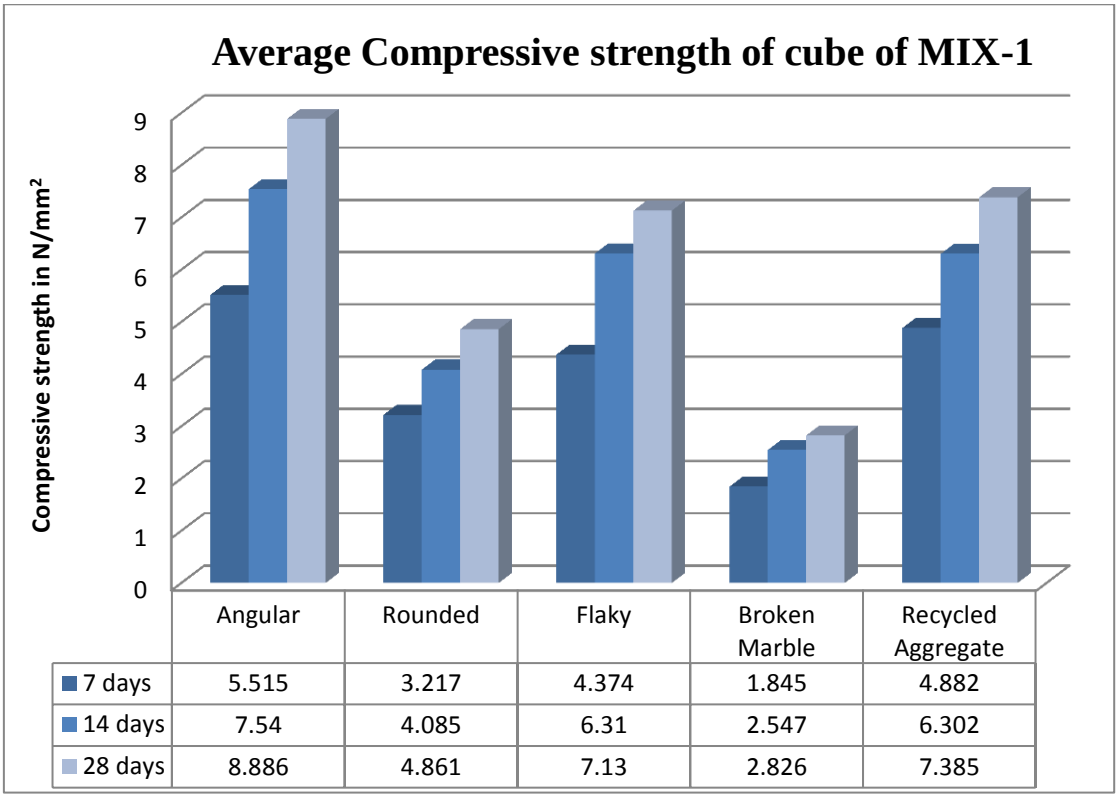
For the above mentioned mixes & samples with different shape and origin of coarse aggregate including broken marble & recycled aggregate as replacement for the coarse aggregate compressive strength test was performed following tables as well as chart represent the findings:-

Table 5.1 Average Compressive strength of concrete for different shape & types of aggregate of MIX-1

S.No	Aggregate type	Compressive Strength (MPa) Mix-1		
		7 days	14 days	28days
1	Angular	5.515	7.54	8.886
2	Rounded	3.217	4.085	4.861
3	Flaky	4.374	6.312	7.130
4	Broken marble	1.845	2.547	2.826
5	Recycled Aggregate	4.882	6.302	7.385

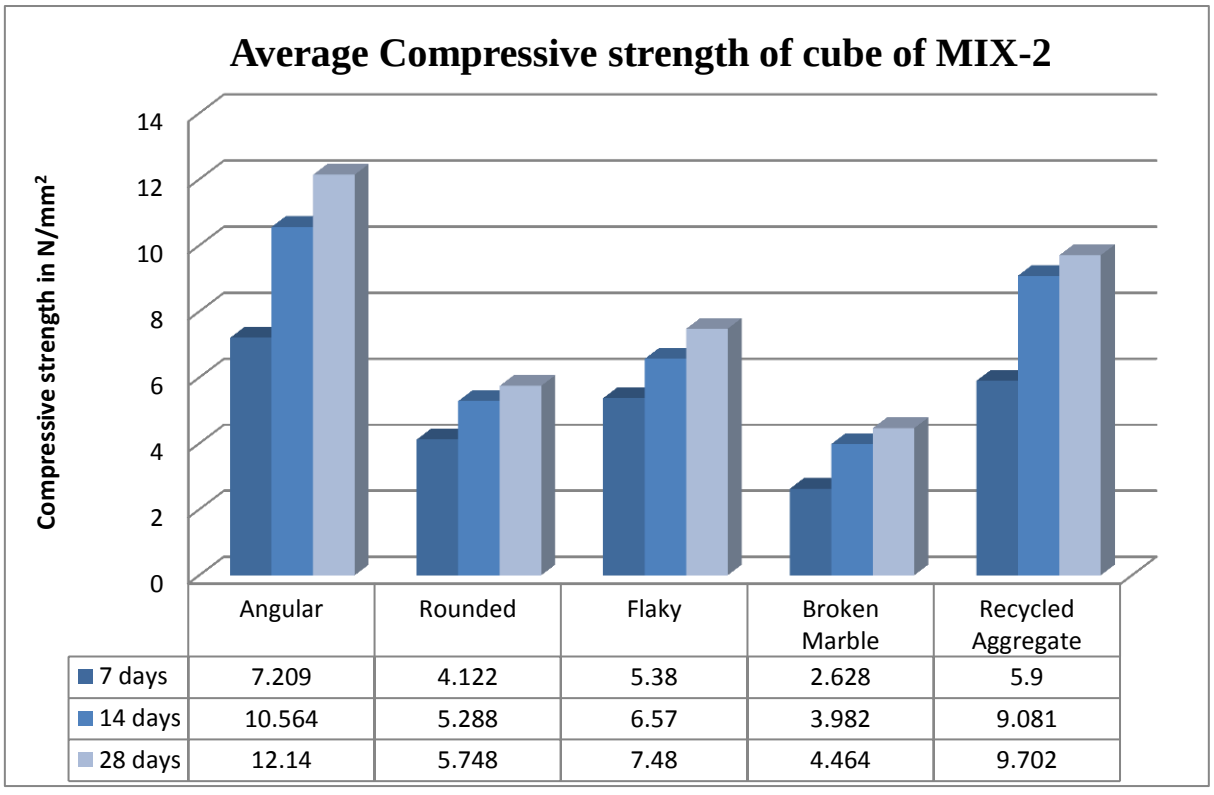
Table 5.2 Average Compressive strength of concrete for different shape & types of aggregate of MIX-2

S.No	Aggregate type	Compressive Strength (MPa) Mix-2		
		7 days	14 days	28days
1	Angular	7.209	10.564	12.14
2	Rounded	4.122	5.288	5.748
3	Flaky	5.38	6.57	8.48
4	Broker	2.628	3.982	4.464
5	Recycled Aggregate	5.90	9.081	9.702



	Angular	Rounded	Flaky	Broken Marble	Recycled Aggregate
7 days	5.515	3.217	4.374	1.845	4.882
14 days	7.54	4.085	6.31	2.547	6.302
28 days	8.886	4.861	7.13	2.826	7.385

Chart-5.2 Average Compressive strength of concrete cube



	Angular	Rounded	Flaky	Broken Marble	Recycled Aggregate
7 days	7.209	4.122	5.38	2.628	5.9
14 days	10.564	5.288	6.57	3.982	9.081
28 days	12.14	5.748	7.48	4.464	9.702

V- CONCLUSIONS

The following are the conclusions and recommendations made by this study. According to the experimental results, it has been observed that,
From the experiments conducted on the Curing of concrete, developed in the concrete laboratory of RSR RCET, Among the all types of aggregate used the following conclusions have been made.

- The compressive strengths of cubes made up of angular and recycled aggregate are considerable.
- The compressive strength of cubes remarkably increases by adding fine aggregate for the preparation of pervious concrete.
- The compressive strength and resistance property to wearing of concrete made by recycled aggregate is near to the pervious concrete made by angular aggregate
- The compressive strength of pervious concrete with 12 mm size aggregate are remarkably more than pervious concrete of 20 mm size aggregate.
- The Mix-2 gives approximately 30.91% more compressive strength as compare to Mix-1.
- The replacement of aggregate by recycled aggregate rather than broken marble is more effective. Hence recycled aggregate can be used to make the thirsty concrete.
- Flaky aggregates which are generally exceptional are waste material also perform an excellent alternate of conventional aggregate.

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