A STUDY ON EFFECT OF ARTIFICIAL AGGREGATE ON MECHANICAL PROPERTIES OF CONCRETE

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ABSTRACT

Construction industry is growing rapidly, resulting in immense usage of concrete: a basic construction material. Increasing use of conventional concrete leads to environmental pollution, depletion of natural resources and global warming at large. Hence the time has arrived to develop alternate material to make concrete to save our mother earth for the coming generation. In this thesis, natural conventional aggregate is replaced by artificial aggregate made from ceramic material is tested for its compressive strength, flexural strength, crushing value, impact value test, pullout test and drop impact test for different concrete mixes with different percentages of artificial aggregate and natural aggregate by 0%, 20%, 40%, 80%, 100% *after 7 and 28 days curing period has done. Comparative study of conventional aggregate with artificial aggregate thus represented in this study.*

Keyword: *concrete, ceramic artificial aggregate, different shape of aggregate, compression strength and flexural strength, split tensile test, pullout test, drop impact test*

1. I INTRODUCTION:

In accordance with conservation efforts, this research focuses on ceramic media as partial coarse aggregates replacement for concrete production, prevention of environmental pollution with considering the elements of sustainable and cost-saving construction projects, especially material usage. Concrete is a composite material consist of mainly water, aggregate, and cement. The physical properties desired for the finished material can be attained by adding additives and reinforcements to the concrete mixture. Here we are replace natural aggregate with artificial aggregate to increase the strength and make low weight concrete and also try to reduce the nature depleting. There are many material which are used in concrete to and make replacement of material.The aggregate which are used in construction are natural aggregate and depleting the nature so we have to replace with ceramic material. Aggregate is most widely used in reinforced concrete construction and there is demand on natural aggregate for the growing infrastructure industry, which creates problem of depleting Natural resources. The coarse aggregate is natural material so one time may be shortage or finish in future, so we have to replace it with alternate material for coarse aggregate. We are replacing concrete with different material but that's not good for long term and for practical purpose so we need to make or utilization of artificial aggregate.

2. II OBJECTIVE:

- To evaluate the fresh properties of concrete (slump test) with use of different shape of artificial aggregate replacement of (0%, 20%, 40%, 80%, 100%).
- To achieve the harden properties (compressive strength, split tensile test and flexural strength) of concrete with use of artificial aggregate replacement of (0%, 20%, 40%, 80%, 100%).
- Pullout test and drop impact test of concrete with use of artificial aggregate replacement of (0%, 20%, 40%, 80%, 100%).

- To use ceramic media of different shape and size rhombus shape and round shape in concrete work as replacement of natural aggregates and analyze the mechanical properties of concrete.
  To investigate the effect of different shape of artificial aggregate on concrete.

3. MATERIAL:

I. Cement:

Ordinary Portland Cement of 53 Grade of brand name Ultra Tech Company, available in the local market was used for the investigation. Care has been taken to see that the procurement was made from single batching in air tight containers to prevent it from being effected by atmospheric conditions. The cement thus procured was tested for physical requirements in accordance with IS: 169-1989 and for chemical requirement in accordance IS: 4032-1988.

II. Water:

Water used or mixing and curing shall be clean and free from injurious amount of oils, acid, a;kalis, salt, organic material or other deleterious material. Potable water fit for drinking is required to be used in the concrete and it should have pH value ranges between 6 to 9.

III. Fine aggregate:

River sand locally available in the market was used in the investigation and conforming to zone II as per IS: 383-1970. The sand was surface dried before use.

IV. Coarse aggregate:

The Crushed aggregates of less than 12.5mm size produced from local crushing plants were used. The aggregate exclusively passing through 12.5mm sieve size and retained on 10mm sieve is selected. The aggregates were tested for their physical requirements such as gradation, fineness modulus, specific gravity and bulk density in accordance with IS: 2386-1963. The individual aggregates were mixed to induce the required combined grading.

V. Artificial aggregate:

- The grinding media which are manufacture in ceramic industry for other use we have to use as a artificial aggregate in concrete replacement with natural aggregate.
- High thermal shock resistance
- Better impact resistance
- A smoother ,regular and uniform surface
- Very high chemical attack resistance.
- Water absorption is very low.

Chemical properties of artificial aggregate:

- Material safety data sheet of ceramic media are manufactured by micro (devson group) industrial ceramics.
- (Ref. Devson insulator pvt.ltd.) Wadhwan G
  IDC-2, surendranagar.

Table 1: Chemical properties of artificial aggregate:

Contain	percent value
Aluminum Oxide	35% - 45%
Silica	47% - 57%
Alumina Oxide + silica	>92%
Potassium Oxide	2% - 5%
Sodium Oxide	2% -5%

Cao	0% - 0.5%
Mgo	0% - 0.5%
Iron oxide	1% - 2%
Titanium Oxide	1% - 2%

4. EXPERIMENTAL PROGRAM:

- Selection of material with testing of Mechanical properties.
- Assessment of Mix design
- Selection of mix proportion and replacement:

(A) Mechanical property of natural aggregate with artificial aggregate:

Table 2: Compression: artificial aggregate Vs Natural aggregate

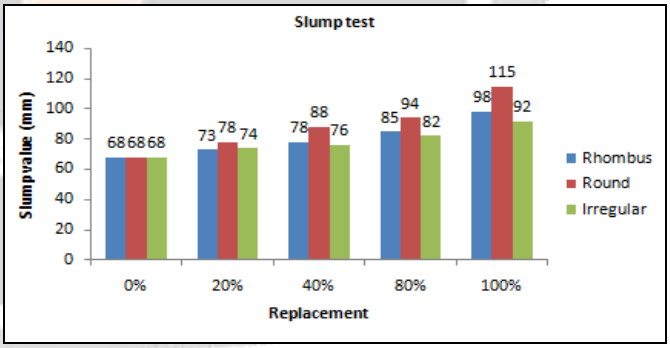
Properties	Artificial aggregate	Natural aggregate
Specific gravity %	2.5	2.69
Water absorption %	0.2	0.43
Impact value %	12.98	7.9
Crushing value %	11.1	19.68
Bulk density kg/m3	1547	1447
Abrasion value	12.92	17.81

(B) Slump test

Table 3: Slump test result

NO.	REPLACE--MENT	Slump value (mm)		
		Rho	ROU	IRREG
1	0%	68	68	68
2	20%	73	78	74
3	40%	78	88	76
4	80%	85	94	82
5	100%	98	115	92

Graph 1: slump test

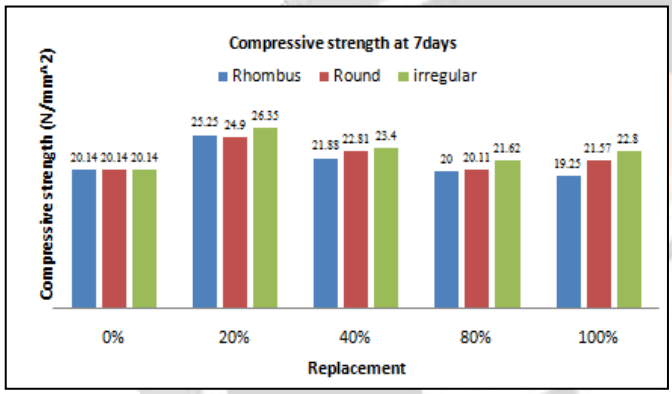


- Slump value gradually increases with increase in replacement o2f percentage of artificial aggregate from (0%, 20%, 40%, 80%, 100%)
- The result shows that at 100% replacement of artificial aggregate with natural aggregate gives maximum value of slump because artificial aggregate as low water absorption.
- As per the result round shape gaining maximum slump respect to rhombus and irregular shape.

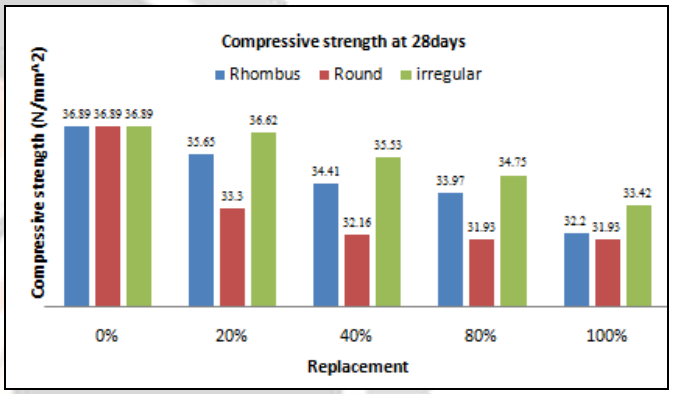
(C) Compressive strength 7 days & 28 days result:

Table 4: Compressive strength 7 days & 28 days result:

No	Replacement	Compressive strength at 7days			Compressive strength at 28 days TMS(31.6)		
		Rhombus	Round	Irregular	Rhombus	Round	Irregular
1	0%	20.14	20.14	20.14	36.89	36.89	36.89
2	20%	25.25	24.9	26.35	35.65	33.3	36.62
3	40%	21.88	22.81	23.40	34.41	32.16	35.53
4	80%	20	20.11	21.62	33.97	31.93	34.75
5	100%	19.25	21.57	22.8	32.2	31.93	33.42



Graph 2 Compressive strength at 7 days



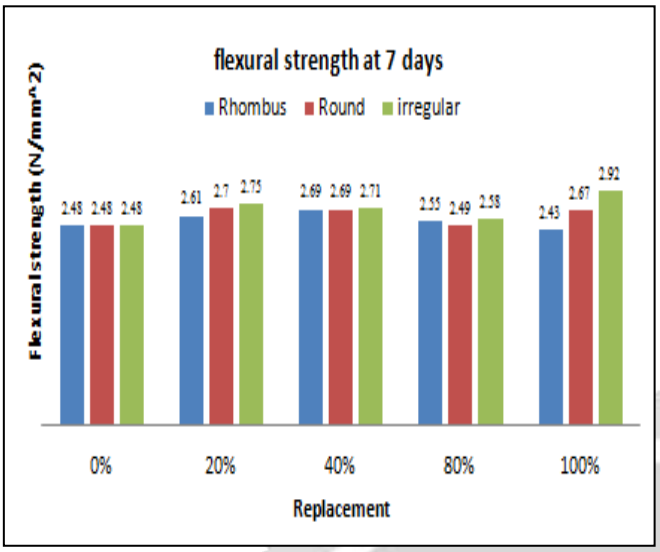
Graph 3 Compressive strength at 28 days

- In M25 artificial aggregate ie in rhombus shape gives maximum compressive strength of 25.25 N/mm^2 at 20% replacement of artificial aggregate.
- Analysis of result irregular shape artificial aggregate gain more compressive strength as compare to round and rhombus shape aggregate.
- At 100% replacement of artificial aggregate to natural aggregate compressive strength is all most near to target mean strength of M25 grade.(TMS 31.6)

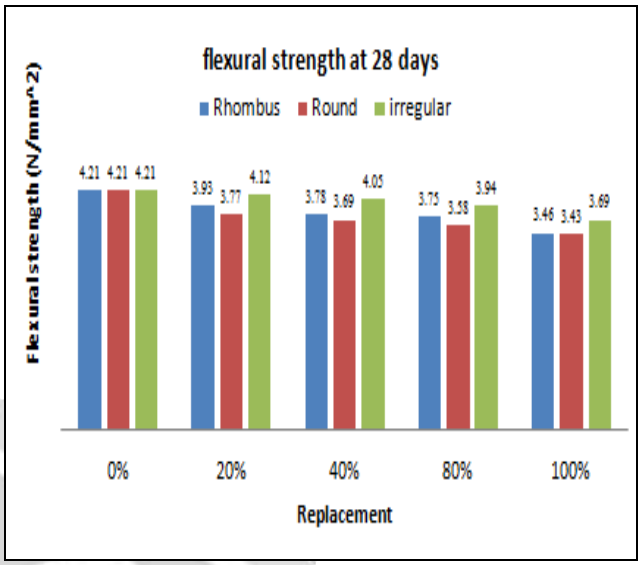
(D) Comparison table of flexural test result of round, rhombus and irregular shape:

Table 5: flexural strength 7 days & 28 days result:

No	Replacement	flexural strength at 7 days			flexural strength at 28 days		
		Rhombus	Round	Irregular	Rhombus	Round	Irregular
1	0%	2.48	2.48	2.48	4.21	4.21	4.21
2	20%	2.61	2.7	2.75	3.93	3.77	4.12
3	40%	2.69	2.69	2.71	3.78	3.69	4.05
4	80%	2.55	2.49	2.58	3.75	3.58	3.94
5	100%	2.43	2.67	2.92	3.46	3.43	3.69



Graph 4 Flexural strength at 7 days



Graph 5 Flexural strength at 28 days

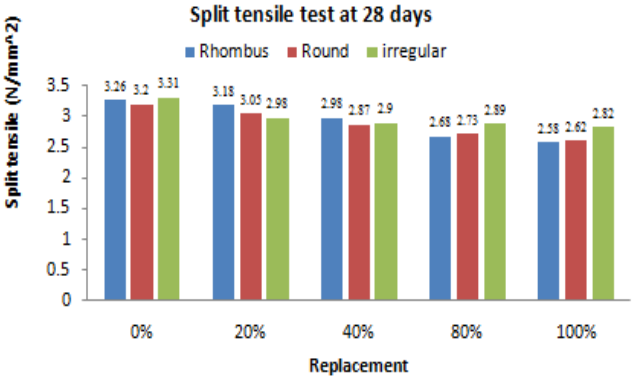
- At 100% replacement of artificial aggregate to natural aggregate I irregular shape give more flexural strength.
- Result shows flexural strength gradually decrease with increasing percentage replacement of artificial aggregate to (0%, 20%, 40%, 80%, 100%)

(E) Comparison table of split tensile test result of round, rhombus and irregular shape:

Table 6: Split tensile strength 28 days result:

No	Replacement	split tensile test at 28 days		
		Rho	Rou	Irre
1	0%	3.26	3.2	3.31
2	20%	3.18	3.05	2.98
3	40%	2.98	2.87	2.9
4	80%	2.68	2.73	2.89
5	100%	2.58	2.62	2.82

Graph 6: Split tensile strength at 7 days

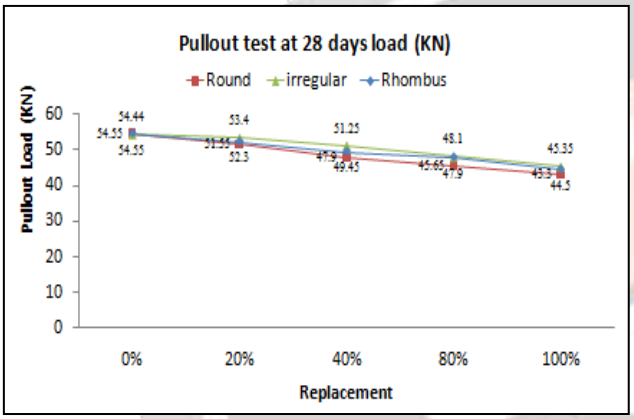


- As per result in irregular artificial aggregate maximum split tensile strength measured 2.98 N/mm^2 at 20% replacement.
- Result shows split tensile strength value varies from 3.18 to 2.58.

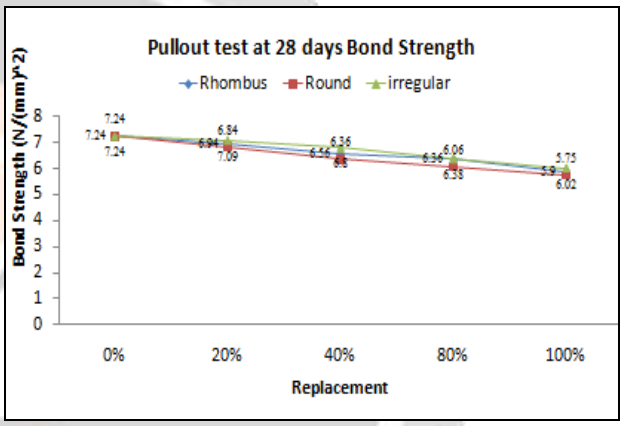
(F) Pullout test:

Table 7: Pullout test load value 28 days result:

No	Repla cement	pullout test					
		Rhombus		Round		Irregular	
		Pullout Load (KN)	Bond Strength (N/(mm)^2)	Pull Out Load (KN)	Bond Strength (N/(mm)^2)	Pullout Load (KN)	Bond Strength (N/(mm)^2)
1	0%	54.55	7.24	54.55	7.24	54.44	7.24
2	20%	52.30	6.94	51.55	6.84	53.40	7.09
3	60%	49.45	6.56	47.90	6.36	51.25	6.80
4	80%	47.90	6.36	45.65	6.06	48.10	6.38
5	100%	44.50	5.90	43.30	5.75	45.35	6.02



Graph 7: Pullout test load (KN)



Graph 8: Pullout test Bond strength

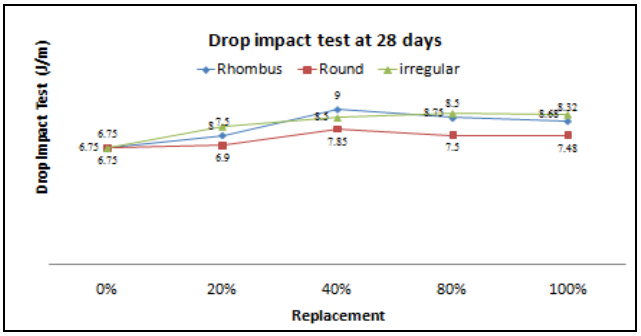
- Pullout test load value gradually decreases with increase in replacement of percentage of artificial aggregate from (0%, 20%, 40%, 80%, 100%).
- Bond strength in pullout test also decrease with increase with percentage replacement of artificial aggregate increase.
- Value of Bond strength of artificial aggregate of rhombus, round and irregular shape is 5.90, 5.75, 6.02.

(G) Drop impact test:

Table 8: Drop impact test

No	Replacement	Drop impact test J/m		
		Rhombus	Round	Irregular
1	0%	6.75	6.75	6.75
2	20%	7.50	6.90	8.00
3	60%	9.00	7.85	8.50
4	80%	8.50	7.50	8.75
5	100%	8.32	7.48	8.68

Graph 8: Drop impact test



- In irregular shape of artificial aggregate maximum drop impact value achieved is 8.75 J/m at 80% replacement of artificial aggregate.
- After result analysis its shows that the drop impact value in irregular shape to artificial aggregate is comparatively high as compared to rest to other.
- The value of drop impact test varies randomly in all the shapes of artificial aggregate as replacement as(0%, 20%, 40%, 80%, 100%).

5. CONCLUSION AND RESULTS:

- Slump value gradually increases with increase in replacement of percentage of artificial aggregate from (0%, 20%, 40%, 80%, 100%).
- The result shows that at 100% replacement of artificial aggregate with natural aggregate gives maximum value of slump because artificial aggregate as low water absorption
- At 20% replacement, compressive strength is increase by 22.93% in rhombus shape and 21.22% increment in round shape of artificial aggregate.
- For 20% replacement of artificial aggregate in both shape its gain more compressive strength. Then after it will be decreases.
- Flexural strength in both rhombus shape and round shape is all most same is at 40% of replacement is 2.69 N/mm2
- As per result in irregular artificial aggregate maximum split tensile strength measured 2.98 N/mm^2 at 20% replacement.
- Result shows split tensile strength value varies from 3.18 to 2.58.
- Pullout test load value gradually decreases with increase in replacement of percentage of artificial aggregate from (0%, 20%, 40%, 80%, 100%).
- Value of Bond strength of artificial aggregate of rhombus, round and irregular shape is 5.90, 5.75, 6.02.

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