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Characteristics of Concrete Made with Partial Replacement of Natural Aggregates by Aggregate Recovered from Waste Concrete

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Abstract : **The management of construction waste has become on issue of great concern. Development of any infrastructure is accompanied by demolition, renovation and reconstruction of existing structure like building, bridges, roads etc. The waste generated mainly consists of inert materials such as concrete, plaster, wood, metal, broken tiles, bricks, masonry etc. This sources of construction waste has become alternative materials for construction traditionally soil, stone aggregates, sand, bitumen, cement etc. are used for road construction. Natural materials being exhaustible in nature, its quantity is declining gradually. Also, cost of extracting good quality of natural material is increasing. The amount of concrete needed in construction is maximum compared with other building materials and thus also generates maximum waste. The aggregate resources have started depleting fast. In the present scenario it has become necessary to recycle concrete. In the present work properties of concrete made by using aggregate from demolished concrete structure are investigates. Concrete made with aggregate up to 40% from demolished structure shared. In flexure negligible reduction only 5% and up to 20% reduction in compressive strength.**

Key words; Waste concrete aggregate (WCA); Compressive strength; Workability; Flexural strength.

1. INTRODUCTION:-

Concrete is widely used as a material for construction of various type of structures. The growing environmental concerns, increasing scarcity of landfills, rapidly depleting sources of quality aggregate in some region coupled with the increasing haulage and growing land fill costs are driving force promoting the recycling concrete demolition waste in new concrete. One of the major challenges of our present society is the protection of environment. Some of the important
elements in this respect are the reduction of the consumption of energy and natural raw materials and consumption of waste materials. The utilization of recycled aggregate is particularly very promising as 75 per cent of concrete is made of aggregates. The total quantum of waste from construction industry is estimated to be 12 to 14.7 million tons per annum out of which 7-8 million tons are concrete and brick waste. According to findings of survey, 70% of the respondent have given the reason for not adopting recycling of waste from Construction Industry is "Not aware of the recycling techniques" while remaining 30% have indicated that they are not even aware of recycling possibilities.

Be resource efficient construction practices is lacking in most countries. At the same time it is to be mentioned that Many European countries had made considerable achievements to utilize the construction wastes in the past decades. The countries like U.K, U.S.A., France, Denmark, Germany and Japan have succeeded in developing economically feasible technologies for recycling up to 80 or 90 percent of C&D waste. However least effort has been reported for the utilization of construction waste in India [1]. A huge quantity of waste is produced every year from construction site, material factories, demolition sites etc. Storage and disposal of these wastes becomes a serious environmental problem because of lacking of sites in main Cities. The properties of recycled aggregate satisfies the specification concrete is made by replacing.

2. REVIEW OF LITERATURE :-

Hoo-Ji chen (2003)[8] investigated mechanical properties of concrete made by using bricks and tiles in different proportion. Other used bricks and tiles content up to 67% compressive strength of concrete redoes by 60% content of recycled aggregate have very loss effect an modulus of elasticity. Washing aggregate improved quality of concrete at high water cement ratio compressive strength similar to normal concrete. Flexural strength of recycled concrete was found to be 78-91% that of normal concrete.

Naguchi(2012)[5] proposed a desing concept for complete recycling of concrete and introduced a new technology for sustainable resource recycling with low energy construction.

Revathi P and Sangetevelins [4]. Used recycled aggregate up to 100% and tested flow & properties of fresh concrete and compressive and tensile strength of hardened concrete. Recycled aggregate concrete showed decreased slump flow passing ability which can be improved by adding adding of super plasticizer. Up to 50% reduction in compressive strength was only marginal and 10 to 20% in cone having 75 to 100%.

Parekh and Modhera (2011)[11], Gonzalez and Martinez (2003)[12], Yong and Teo (2009)[9] Rasheeduzzafar and Khan[11] have studies the properties of WCA concrete and revealed that the waste aggregate drastically lowers the workability of WCA . It may be attributed to higher water absorption of recycled aggregate.

3. MATERIAL AND METHOD; –

A block of concrete from demolished column was used to recover aggregate for recycling the concrete blocks were broken into piece manually by means of hammer to separated the mortar added to the aggregates. Some quantity of mortar remain attached to the aggregate, the Portland pozzolana cement of 43 grade was used as binding material .

Locally available river sand (zone 1) is used as fine aggregate. And locally available crushed granite of 20mm minimum size is used as coarse aggregate.

The properties of cement was satisfy the specification of IS 1489-1991. Natural and recycled coarse aggregate were tested in accordance with IS2386(part IV)-1963.

4. WASTE CONCRETE AGGREGATE(WCA);-

The properties of aggregate recovered from cement block and relevant stander specification as per IS 383-1970 are given in table-1

The control mix of M-25 grade was carried out as per IS10262-198 for severe exposed condition. the mix proportion designed as 1:1.5 : 2.3 with water cement ratio of 0.40

Three concrete mix were produced by replacing natural aggregate by 30%, 40% and 50% recycled aggregate and designed as WCA 30%, WCA 40%and WCA 50% respectively. The grading curve of waste cement aggregate is shown in fig.1. The fineness modulus of WCA was 5.30. The grading curve of all in aggregate for different mixes are shown in fig. 2

Proportions of ingredients used in mixes are given in table –2.

Concrete mixes were prepared in laboratory by hand mixing properties of fresh concrete mix were obtain by performing slump test , compaction factor test and flow table test for each mixes.

From each mix nine 150x150x150 mm cubes and two 150x150x700 mm beams are cast. Compressive strength of cube at age of 3 day,7 day and 28 days were determine. 28 days compressive strength of cube was also determine by using Schmidt's rebound hammer. Flexural test was performed on beam to investigating the ultimate strength of beams for each mix.

The natural aggregate and recycled aggregate satisfied the standard requirement for aggregate used in concrete.

Test result of slump cone test, compaction factor test and flow table test are given in table 3.

The flow properties of fresh concrete found satisfactory. Compressive strength of cubes as deter mined by caring out non destructive and destructive test a compression testing aretubulated in table-4.

For flexure test load is applied on two points. The arrangement for the test is shown in Fig 3. The load is increased till the failure is show in fig 4. The aggregate recovered from waste concrete prose sufficient strength as caucusing and impact value are within the standard limit by IS code. The flow properties of WCA concrete are satisfactory. Compressive strength of WCA concrete was reduce by up to 30% When compared with control concrete showing Fig.5. Decrease in flexural strength of beam is very less. showing in Fig.6

5. CONCLUSION;-

The large requirement of concrete needed in infra structures require huge amount of aggregate. Construction can be made sustainable by recovering aggregate from waste concrete obtained from demolished structure. Advanced countries involved in extensive research for recycling and have already developed technology to recycle concrete (Naguchi,2012). Three standards have beam established for recycled aggregate for concrete depending upon their. Different techniques are available for repressing aggregate from demolished concrete.

It is urgently required to developed feasible technology for recovering aggregate from waste concrete an large scale as well as small scale. Initiative is needed to be taken by research intuition is developing polity to support recycling of aggregate and government should support such as effect. For effective implement of policy proper management of waste concrete is also necessary. Further relevant IS-specification be developed regarding the quality and method of using recycled aggregate.

Table-1

S. No	Mechanical Properties	Value as per IS –383	Value for aggregate for waste concrete	Remark
1	Crushing value	45%(Max)	27%	With in limit
2	Water absorption	0.5%(Max)	5.35(30 min.) 1.24(24 hrs)	Material attached get dissolved
3	Fineness modulus	2.9 to 3.2	5.30	65% higher
4	Absorption Value	50%	17%	With in limit

Table-2
Mix proportion for various WCA mixes for 1cum.

Replacement of aggregate	W/C	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate		Water
				NA	WCA	
Control	0.40	493	743	1140	-	197
WCA30%	0.40	493	728	798	342	197
WCA 40%	0.40	493	718	684	456	197
WCA 50%	0.45	493	708	570	570	202

Table -3
Slump, Flow table and compaction factor

Particulars	W/C ratio	Slump mm	Flow in %	Compaction factor
Control	0.40	25	76%	0.95
WCA30%	0.40	15	72%	0.87
WCA40%	0.40	20	68%	0.85
WCA50%	0.45	20	68%	0.85

Table -4

S. no.	**Control mixes**	**Rebound Number readings**						**Compressive Strength in 28days**	**Percentage Variation**
		1	2	3	4	5	Avr		
1	**NA**	28	28	28	32	32	29.6	32	8.10 %
2	**WCA 30%**	32	22	24	24	26	25.6	28	8.57 %
3	**WCA 40%**	30	30	30	28	28	29.6	27	- 7.53 %
4	**WCA 50%**	24	24	26	26	28	25.6	26.6	3.90 %

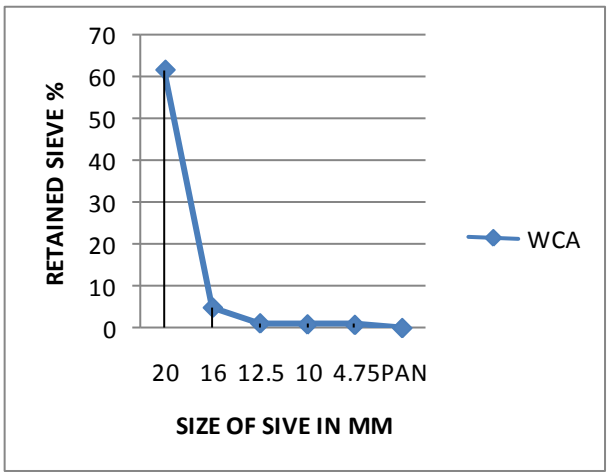


Fig-1 Grading curve of waste concrete aggregate

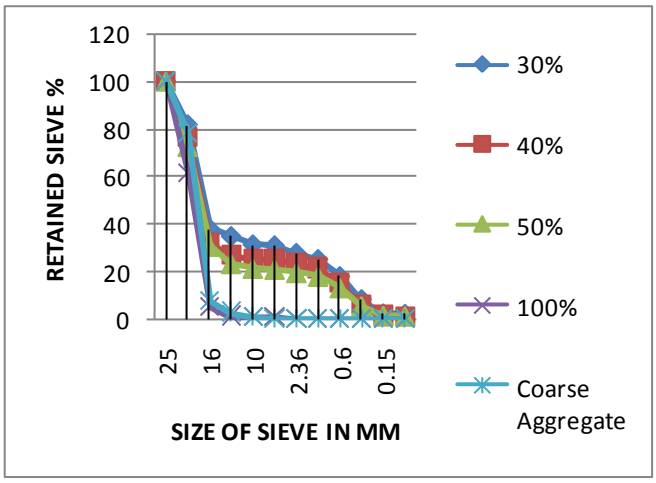
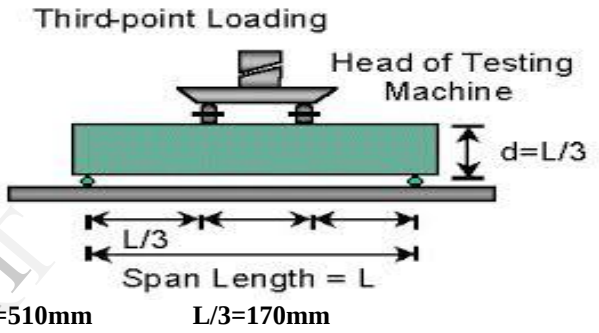


Fig.-2 Grading curve of all in aggregate



L=510mm **L/3=170mm**

Fig-3; Arrangement for flexural test of beam.

Fig-4; Failed beam

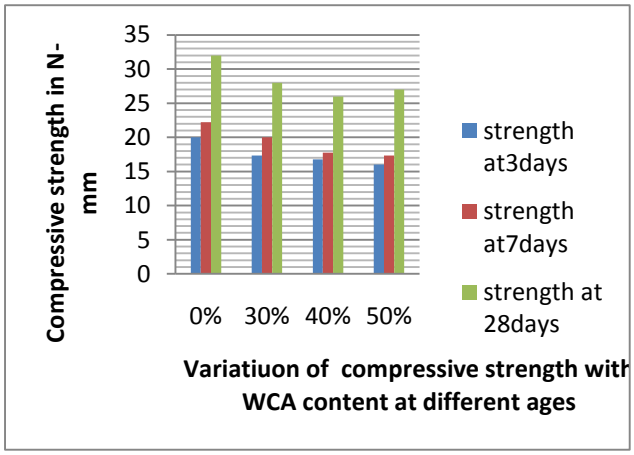


Figure 5 Represents the variation of compressive strength with percentage replacement with WCA concrete.

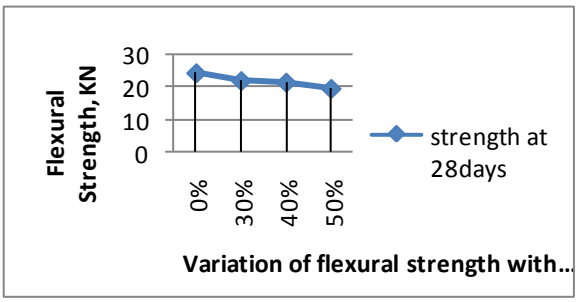


Figure 6: Variation of Flexural strength of beams with different.

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