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Effect of Fly Ash and Recycled Coarse Aggregate in Concrete

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Abstract: *Concrete industry, utilizes 12.6 billion tons of crude materials every year. It's the biggest uses of natural resources in the world. The natural effect of creation of crude elements of cement, (for example, concrete, coarse and fine total) is extensive. The size of issues makes it common sense to examine different wellsprings of crude materials so as to diminish the utilization of energy and accessible regular assets. In the current study, the properties of concrete, when the Natural Coarse Aggregate (NCA) is partially replaced by 30% Recycled Coarse Aggregate (RCA) and cement is partially replaced by fly ash in 10 %, 20% and 30% with various w/b proportions as 0.38, 0.40 and 0.42 are studied. Specimens are casted with natural, recycled coarse aggregate and to be tried after a curing time of 7, 14 and 28 days. The examination was conveyed for workability and Compressive strength test. The utilization of RCA in concrete is another scope of potential reuse of materials in the construction industry.*

Keywords: *Fly ash, Recycled coarse aggregate, Natural coarse aggregate, w/c ratio*

1. Introduction

Concrete is the main construction material utilized generally over the world in a wide range of designing works, it assumes a significant part in shaping our current circumstance and manageability of construction industry. The concrete industry utilizes 12.6 billion tons of raw materials every year. It's the world's most broadly utilized construction materials.

When a structure is demolished after its utilization, for fixes or decay it produces huge measure of C&D squander, which routinely and work today is utilized for land filling. Lately, the recyclable possible development and destruction squander has made it an objective of interest and the primary focal point of waste administration arrangements on empowering minimization, recycle, reusing, and valorisation of waste instead of its last removal in landfills. In the most recent decade, construction industry has been directed using the by-products in concrete.

2. Material Properties

2.1. Fine Aggregate (FA)

The FA utilized for this project are locally obtained and belonged to zone II. The FA is sieved through 4.75mm sieve first, to eliminate particles more prominent than 4.75mm. The FA are tested according to IS specification. Properties of the FA utilized in the project are as shown in Table-1.

Table1. *Fine Aggregate*

S.No	Parameters	Values
1	Specific Gravity	2.56
2	Water Absorption	1.0%
3	Fineness Modulus	3.10

2.2. Coarse Aggregate (CA)

CA utilized in this work are locally available resources. CA which are passing through 20mm sieve and retained on 4.75mm were used and according to IS Specification. The values of different tests on CA are as shown in Table 2.

Table2. *Coarse Aggregate*

S.No	Parameters	Value
1	Specific Gravity	2.71
2	Water Absorption	0.6%

2.3. Cement

The cement used in this work is 53 Grade OPC. The basic properties are tested as in Table-3.

Table3. *Cement*

S.No	Parameters	Value
1	Specific Gravity	3.17
2	Normal Consistency	31
3	Initial and final Setting Time	41 & 590

2.4. Recycled Coarse Aggregate

Unwanted concrete and brick are crushed and separated into recycled aggregate. Aggregate normally make around 55% to 70% of the capacity of a concrete mixture. The C&D waste is mainly due to huge amount of demolition's, lack of dumbing spots, rise in shipping and clearance cost. From the test results, the specific gravity of the RCA is 2.85.

2.5. Fly Ash

Fly ash particles are almost spherical in shape, which makes the concrete to flow and blend easily in mixtures. Fly Ash properties are given in Table 4.

Table4. *Fly Ash*

S.No	Parameters	Values
1	Density(g/cm^3)	2.15
2	Specific Gravity	2.25

3. Experimental Program

In this project RCA is replaced with 30% of the natural coarse aggregate and fly ash replaced with cement in 10%, 20%, 30% & 40% for the water/binder ratio of 0.38, 0.4 and 0.42. For all variations 9 numbers of cube are casted for compressive strength test at 7th, 14th and 28th days. Mixing, casting and curing are as shown in figure 1.

Figure1. *Mixing, casting and curing*

4. Result and Discussions

The specimens are tested for compressive strength at various days and the test set-up in figure 2. The tests values are as shown in Table 5 and the graphs are drawn for compressive strength, w/b ratio, % of RCA and % of Fly ash respectively as shown in Figure 2.

Figure2. *Compressive strength*

The compressive strength of 7 days, 14 days & 28 days result observed, with 30% of Recycled coarse aggregate replaced for natural coarse aggregate, with fly ash replacement about 10%, 20 %, 30% in cement, with varying water cement ratio of 0.38, 0.4, 0.42.

Table5. *Compressive Strength at 7, 14 & 28 days*

Mix Type	% of RCA	w/b	Fly Ash in (%)	Compression Strength in MPa		
				7 days	14 days	28 days
Mix - 1	30	0.38	0	30.8	37.2	47.77
			10	31.2	38.1	48.8
			20	31.1	38	48.9
			30	30.8	37.8	47.2
Mix - 2	30	0.40	0	28.82	33.26	42.65
			10	28.24	33.8	42.8
			20	21.95	34.3	42.9
			30	21	31.58	41
Mix - 3	30	0.42	0	25.89	32.5	41.12
			10	28.2	32.8	41.22
			20	28.6	32.8	41.25
			30	24.85	30.6	38.36

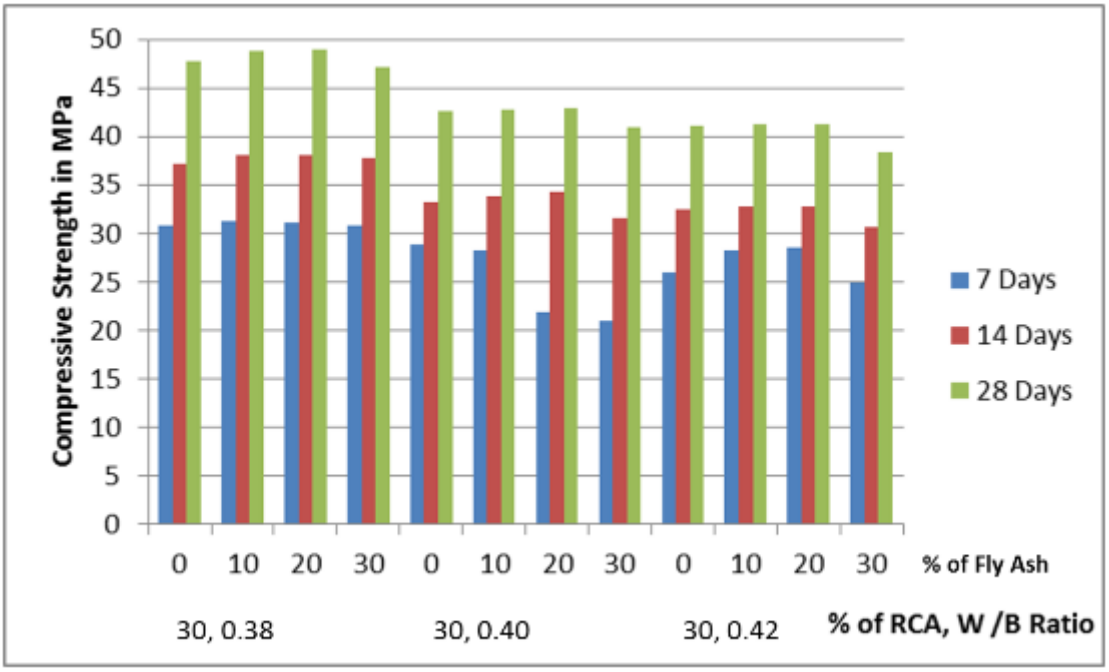

Figure3. *Compressive strength for various % of RCA and fly ash*

5. Conclusion

In the Mix -1, 28 days strength of concrete performed well and achieved higher compressive strength and replacement of fly ash above 20% shows reduced compression strength than the control concrete.

In the Mix -2 & 3 also show the increase in compression strength with 20% fly ash with cement and 30% replacement shows reduced strength then the control concrete.

From the above results it is that the optimum level of cement replacement was found to be 20% of Fly ash.

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