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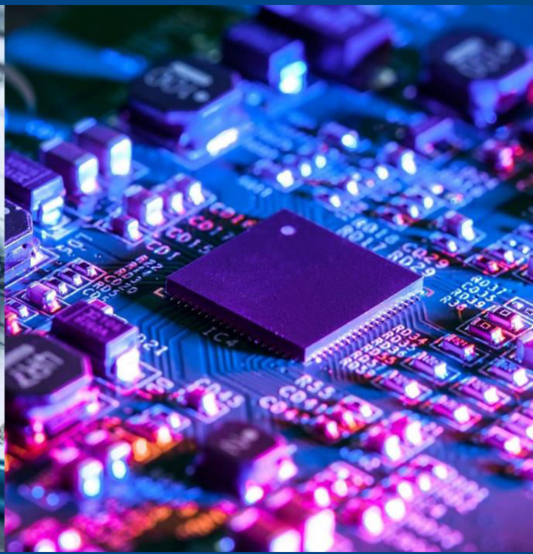

International Journal of Multidisciplinary Research in Science, Engineering and Technology

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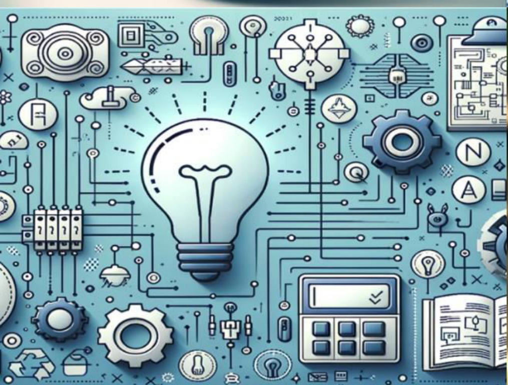

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Experimental Investigation of Multi-blended Concrete with Recycled Coarse Aggregate, Fly Ash, and M Sand

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ABSTRACT: Recycled aggregates are derived from building and demolition waste. As demolition trash production increases, the environment becomes polluted. Using recycled aggregates instead of natural aggregates can help reduce waste. The use of recycled aggregates is becoming more widespread, resulting in cost savings. This paper aims to evaluate the strength of recycled aggregates as an alternative to natural aggregates. Fly ash and M sand are utilized to partially replace the binding material in M30 grade concrete. Concrete is created with recycled aggregates (25%, 50%, 75%, and 100%), fly ash (0%, 5%, 10%, and 15%), and M sand (0, 10%, 20%, 30%, and 40%). IS:10262-2019 is used to create mixes for binary blended recycled aggregate concrete. Mechanical parameters such as compressive strength, flexure, and split tensile strength were assessed over 7 and 28 days. The test findings show that using recycled aggregate and M sand concentration reduces the mechanical characteristics of concrete.

I. INTRODUCTION

The use of recycled materials in concrete production has gained significant attention due to environmental concerns and the need for sustainable construction practices. This study focuses on the experimental evaluation of multi-blended concrete incorporating recycled coarse aggregate (RCA), manufactured sand (M sand), and fly ash. The aim is to assess the properties of this blended concrete in comparison to conventional concrete made with natural aggregates. Utilization of Recycled Coarse Aggregate (RCA) is a topic of interest for environmental and economic reasons. RCA is the aggregate obtained by crushing the waste concrete from construction and demolition sites. It can be used as a partial or full replacement of natural coarse aggregate (NCA) in concrete, depending on the quality and properties of RCA.

Need for the study

The basic ingredients of conventional concrete are cement, fine and coarse aggregates, and water. This study focuses on replacing cement, fine aggregate, and coarse aggregate in concrete with industrial byproducts. Cement is a substance that has the ability to independently set and harden, bind other materials, and harden them. Traditional binding materials were used by ancient civilizations, including lead, jute, jute fibre, jaggery, and rice husk. Cement serves as the main binding agent in modern society. There are two types of aggregates: fine aggregate and coarse aggregate. Even though aggregate typically makes up 70% to 80% of the volume of concrete, it is frequently thought of as inert filler that has little impact on the properties of the final product.

The ideal replacement percentage level for binary and ternary combination mixes for producing high performance concrete is achieved by adding industrial by-products as admixtures, such as recycled aggregate, and fly ash. This method is also used to determine the flexural properties of reinforced high performance concrete beams for binary and ternary mix configurations with the specified industrial by-products.

In a limited sense, research on the aforementioned materials helps to advance their strength and durability traits as well as their ability to conserve natural resources, which has both technical and financial advantages.

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II. OBJECTIVES OF VIEW

A review of prior studies on using Recycled Coarse Aggregate (RCA) in place of natural coarse aggregate (NCA) According to their analysis, fly ash has the potential to produce durable concrete by improving the mechanical properties of concrete.

1. Increase the economy of the construction with using the cheaper material as a replacement of the cement.
2. To compare the Mechanical properties of concrete with different amount of recycled aggregates such as 25%, 50%, 75% and 100%.
3. To compare the hardened properties of concrete with different amount of 0% 5% 10% 15% & 20% of fly ash as replacement of Cement to improve the quality of concrete.
4. To utilize IS 10262:2009 to create the mix design for M30 grade concrete and using the slump cone test to determine the workability.

III. METHODOLOGY OF PROPOSED SURVEY

The following methodology has been adopted in order to achieve the aforementioned goals. The goal of this study is to find a productive method for making high performance concrete with aggregate made of industrial byproducts like RCA, M sand, and fly ash.

1. Mix Design: A systematic approach was adopted for designing the concrete mixes. Various proportions of Recycled Coarse Aggregate (RCA), M sand, and fly ash were tested alongside traditional aggregates to determine optimal performance characteristics. (Using the mix design in IS 10262:2009)
2. Testing Procedures: Standard tests were conducted according to guidelines set by organizations such as ASTM International and IS codes:
   a. Workability Tests: Slump test was performed to assess workability.
   b. Compressive Strength Tests: Cubes were cast and cured for 7, 14, and 28 days before testing their compressive strength.
   c. Durability Tests: Water absorption, permeability, and resistance to chemical attacks were evaluated.
3. Data Analysis: Results from various tests were statistically analysed to understand the impact of different proportions of RCA, M sand, and fly ash on the mechanical properties of concrete.

IV. RESULTS AND DISCUSSIONS

Mix Proportions

Here three mixes of concrete were prepared i.e., without RCA(Mix 1);with RCA, replacement of fly ash by 10% ,(Mix 2); 20% of fly ash and ,(Mix 3). The water-cement ratio is 0.50. To increase the workability of recycled aggregate concrete super plasticizer (SP 430). When super plasticizer (SP430) is used the water-cement ratio is 0.43.

Table 1: Mix Proportion different % of RCA, M-Sand & fly ash

Mix designation	Cement	Fly Ash	Fine Aggregate	M-Sand	Coarse Aggregate	RCA	Water
	kg/m^3	kg/m^3	kg/m^3	kg/m^3	kg/m^3	kg/m^3	kg/m^3
N-Mix	394	0	589	0	1213	0	197
MB-F5-M10-R25	374.3	19.7	530.1	58.9	909.75	303.25	197
MB-F10-M20-R50	354.6	39.4	471.2	117.8	606.5	606.5	197
MB-F15-M30-R75	334.9	59.1	412.3	176.7	303.25	909.75	197
MB-F20-M40-R100	315.2	78.8	353.4	235.6	0	1213	197

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Combined Effects on Compressive Strength

When RCA, M Sand, and Fly Ash are combined in concrete mixes, their interactions can lead to varying outcomes regarding compressive strength:

Table 2: Compressive Strength of concrete and Multi blended mix concrete at 7 days

Mix Design Code	Cube Dimension (mm) Width x Depth	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)	% Increase in Strength at 7 days
N-Mix	150mm x150mm	650.00	28.89	28.97	0.00
	150mm x150mm	653.55	29.05		
	150mm x150mm	651.80	28.97		
MB-F5-M10-R25	150mm x150mm	676.00	30.04	30.29	4.55
	150mm x150mm	679.55	30.20		
	150mm x150mm	688.90	30.62		
MB-F10-M20-R50	150mm x150mm	721.55	32.07	32.09	10.77
	150mm x150mm	722.60	32.12		
	150mm x150mm	721.85	32.08		
MB-F15-M30-R75	150mm x150mm	688.90	30.62	30.68	5.91
	150mm x150mm	692.70	30.79		
	150mm x150mm	689.50	30.64		
MB-F20-M40-R100	150mm x150mm	669.45	29.75	29.82	2.95
	150mm x150mm	671.04	29.82		
	150mm x150mm	672.62	29.89		

Mix Design Code	Cube Dimension (mm) Width x Depth	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)	% Increase in Strength at 7 days
N-Mix	150mm x150mm	862.45	38.33	38.49	0.00
	150mm x150mm	866.85	38.53		
	150mm x150mm	869.05	38.62		
MB-F5-M10-R25	150mm x150mm	904.25	40.19	40.29	4.67
	150mm x150mm	906.45	40.29		
	150mm x150mm	908.65	40.38		
MB-F10-M20-R50	150mm x150mm	955.35	42.46	42.09	9.36
	150mm x150mm	945.55	42.02		
	150mm x150mm	940.25	41.79		
MB-F15-M30-R75	150mm x150mm	935.55	41.58	41.55	7.94
	150mm x150mm	932.65	41.45		
	150mm x150mm	936.15	41.61		
MB-F20-M40-R100	150mm x150mm	905.15	40.23	40.29	4.69
	150mm x150mm	912.65	40.56		
	150mm x150mm	902.05	40.09		

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Beam No.	Length	Distance Between the line of fracture & the nearer support(a)	Load at failure (P) KN	Flexural Strength(fb) N/mm2	Average Strength N/mm2	% Increase in strength at 28 days
N-Mix	**600.00**	213.00	28.00	4.98	**5.03**	**0.00**
	600.00	212.00	28.30	5.03		
	600.00	215.00	28.55	5.08		
B-F5-M10-R25	**600.00**	213.00	29.30	5.21	**5.20**	**3.25**
	600.00	214.00	29.15	5.18		
	600.00	211.00	29.25	5.20		
B-F10-M20-R50	**600.00**	210.00	30.15	5.36	**5.40**	**7.30**
	600.00	209.00	30.75	5.47		
	600.00	211.00	30.25	5.38		
B-F15-M30-R75	**600.00**	211.00	31.15	5.54	**5.63**	**11.95**
	600.00	209.00	32.10	5.71		
	600.00	211.00	31.75	5.64		
B-F20-M40-R100	**600.00**	214.00	30.55	5.43	**5.34**	**6.20**
	600.00	214.00	29.65	5.27		
	600.00	213.00	29.95	5.32		

V. CONCLUSIONS

The following conclusions are made from the study:
Experimental Study of Multi blended concrete by using Recycled Coarse Aggregate, M sand and Fly ash with respect to Coarse, fine aggregate and Cement

1. Study of Multi blended concrete by using Recycled Coarse Aggregate, M sand and Fly ash with respect to Coarse, fine aggregate and Cement .
2. The strength of concrete decreases as the percentage of recycled aggregate increases. This may be due to the loose mortar surrounding the recycled aggregate, which prevents the cement paste and aggregate from properly bonding.
3. 30 MPa is typically used for a variety of structural applications. At 28 days, fly ash and 100% replacement of RCA resulted in strength of 32 MPa.

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