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BENDING STUDY OF HIGH CAPACITY REINFORCED CONCRETE BEAMS

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Abstract: The utility of factory-made derivatives in concrete for the fabrication of high-performance concrete is becoming increasingly appealing. In the case of concrete, factory-made derivatives play the role of small fillers, pozzolanic responses, and hydration responses. The addition of chemicals results in higher strength and a noteworthy reduction in the amount of water added. To improve the overall quality of the concrete, we use factory-made derivatives such as residual ash, smoked silica, and steel slag aggregates. To examine working execution of high-performance concrete, factory-made derivatives such as silica dust, residual ash, and furnace steel waste aggregates are used, which serve as substitutes for cement, fine aggregate, and coarse aggregate, respectively, which is the main focus of the work.

Index Terms - High performance concrete, Residual ash, Furnace steel waste, Silica dust, bending strength.

I. INTRODUCTION

Concrete is without a doubt the most frequently used material for structure building in the world for all sorts of frameworks and, due to its qualities, is a long-lasting substance [1]. Concrete draws raw materials because of its benefits in terms of strength and durability, low fabrication costs and maintenance capacity, flexibility in producing the most various shapes, and structural relevance without the need for metallic components [2]. Using a large number of chemical mixes to reduce the water content to a very low intensity is undesirable, as is the efficiency of chemical combinations that are essentially super plasticizers. Factory-made derivatives improved the flexural performance of HPC beams with a variety of frameworks, including load divergence characteristics, energy ability, torque, flexural behavior, ductility, and load elongation condition, when used. Using a large number of chemical mixes to reduce the water content to a very low intensity is undesirable, as is the efficiency of chemical combinations that are essentially super plasticizers [3]. During the hydrogenation process, pozzolanic material, as well as factory-made by-products such as silica dust, residual ash, and furnace steel waste, which are used in lieu of concrete components such as cement fine aggregate and coarse aggregate, mix. For HPC combinations, the w / c ratio is assumed to be 0.55, and the content to which cement is substituted by silica fume varies as 10%, 15%, 20%, and 25% by the volume of cement taken, fine aggregate is substituted by residual ash, the amount of which varies as 5%, 10%, 20%, 30%, and 40% by the volume of fine aggregate.

II. DURABILITY OF HIGH-PERFORMANCE CONCRETE

The presence of the concrete is unsafe since it must tolerate the environment under which the formation is done in order for the structure to exist. According to observations, high-quality concrete may not function well in a violent setting [4]. The word "durability" is used to characterize the ability of concrete to withstand the variety of physical as well as the chemical assaults induced by their external and internal sources on the properties of the concrete [5]. The accurate collection and application of material units is required for the creation of high-quality concrete.

III. SPECIMEN PREPRATION FOR SINGLE COMBINATION

Steel moulds are used to make standard-sized test samples including cubes, cylinders, and prisms. The mould was lubricated before the samples were poured. To test compressive strength, 10 cubes are produced, 10 cylinders slide to determine split wire strength, and 10 prisms are moulded to assess bending strength.

Table 1

Mix	W/C	Water (lit)	SP (ml)	Slump (mm)
CC	0.55	174.60	44	54
SFC1	0.55	166.40	31	61
SFC2	0.55	147.20	42	66
RAC1	0.55	177.70	33	59
RAC2	0.55	178.50	34	61
SSAC1	0.55	177.50	29	61
SSAC2	0.55	177.50	37	65

IV. MIX PROPORTIONING

The combination's design is based on the definite volume approach stated in IS 10262-1982. Several blends are produced to achieve a grade of M30 at water cement ratios ranging from 0.40-0.55, and their compressive strength is evaluated. In order to achieve the precise configuration of performance and homogeneity criteria, a comparably best feasible HPC combining ratio is necessary. For HPC combinations, the w / c ratio is assumed to be 0.55, and the content to which cement is substituted by silica fume varies as 10%, 15%, 20%, and 25% by the volume of cement taken, fine aggregate is substituted by residual ash, the amount of which varies as 5%, 10%, 20%, 30%, and 40% by the volume of fine aggregate

V. STRENGTH PARMATER STUDY

- **Bending Strength Study:**

The bending strength calculation is important for calculating the load under which the concrete sections can rupture alongside. Each form of design necessitates the calculation of stress in bending at failure or modulus of failure. Using a prism with dimensions of 100mm x 100mm x 500mm in a bending examination apparatus having a capacity of 1000kN in reference with IS:516 1959, the sample for testing was subjected to two-point load for 28 days.

Fig1 :Test Setup for Bending strength

Formula used to calculate bending strength of the test specimen

$$f_r = \frac{P}{BD^2}$$

fr = strength in bending of the sample in MPa

P = maximum load in N

L = span supported in mm

B = width of the sample in mm, and

D = failure point depth in mm

Test outcome for bending strength are show in table 2

Table 2

S. No.	Code Mix	Bending strength in (MPa)
1	CC	7.09
2	SFC1	9.11
3	SFC2	8.07
4	RAC1	8.74
5	RAC2	8.01

Where SFC represent the slag furnace cement specimen and RAC represent the Residual ash

Compressive Strength Study:

Various combinations for RA were created by substituting cement, FA (fine aggregate), and CA (coarse aggregate) with factory-made derivatives. the substitution percentage 10 % , 15 % , 20 % and 25 % by volume and for SSA and RA the substitution percentage is 5 % , 10 %t , 20% , 30 % and 40 % by volume from them we made different blends.

Table 3

S. No.	Code Mix	Compression strength in MPa
1	CC	34.33
2	SFC1	36.65
3	SFC2	31.33
4	RAC1	34.41
5	RAC2	33.45

Tensile Strength Study:

Strength of concrete within the tensile zone considered to be important in rupture process of the concrete specimens. Tensile strengths in concrete can be direct or indirect. The modulus of rupture is indirect test in the determination of the tensile strength of cylindrical sections. The rupture strength of concrete cylinder sections was tested at 28 days by a compression testing equipment having capacities of 1500KN, height and diameter of 300mm and 150mm, respectively. The tension stress on SFC, RAC, and SSAC combinations was found out after a time period 28 days of curing. Tensile stresses were applied to the cylinders, and the mean values were obtained

Table 4

S.No.	Code Mix	Split tensile strength in MPa
1	CC	2.79
2	SFC1	3.09
3	SFC2	3.75
4	RAC1	3.82
5	RAC2	3.54
6	SSAC1	3.36
7	SSAC2	3.15

VI. RESULT AND DISCUSSION

When 10% of the cement component of concrete is substituted with the silica dust, the compression strength of the concrete rises by 6.75% when compared to CC after a time period of 28 days of curing; the average compression strength is 32.78MPa. When 10% of the volume of fine aggregate is substituted with residual ash, the compression strength improves by 0.23%, and the average compression strength is found to be 32.62MPa. Correspondingly, when the (CA) coarse aggregate is substituted with furnace steel waste aggregates for 10% of the volume of cement concrete, the compression strength improves by 15.84%, with an average numerical value of 35.91MPa.

SFC mix bending and tensile strength have risen by 27.28 percent and 22.40 percent, respectively. Only in the event of SF mixes may the strength be improved to a maximum of 10%; however, if the amount is increased over 10%, the strength is diminished. When compared to cement concrete, the tensile and bending strength of the RAC blend rose by 26.42% and 25.73%, respectively. When compared to cement concrete, the SSAC blend improves its tensile and bending strength by 26.08percent and 17.99percent, respectively.

VII. Conclusion

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