Mechanical Properties of concrete using bottom ash and M.Sand

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Abstract - The present study is to investigate experimentally the mechanical properties of concrete made using partial replacement of bottom ash 20% and manufacturing sand of 25%, 50%, 75%, 100% for cement and fine aggregate respectively. From the result it was found that there was marginal increase in workability when manufacturing sand content increases. The compressive strength of concrete increases when percentage of manufacturing sand increases up to 75% and decreases when 100% replacement. The split tensile strength varies marginally.

Keywords – Bottom ash, manufacturing sand, compressive strength, split tensile strength

I. INTRODUCTION

During the last few decades the "waste" materials have seen a transformation to the status of "by-products" and more recently "products" that are sought for construction and other applications. As several residual material properties suited for concrete production. It can reduce the energy to make concrete, and it is also a more economical concrete than the conventional one. This research is undertaken on the use of Lignite-base Bottom ash as binder replacement and M.Sand as fine aggregates in structural grade concrete-making.

In India, about 100 million tones of fly ash is produced by electric thermal power plants, out of which 20 to 30 per cent is Bottom ash. Bottom ash is the fine, solid mineral residue that results from the burning of coal in boilers. Currently, about 80 per cent of coal combustion by-products are treated stored in surface impoundments, mines and quarries or land-fill [7]. Approximately 30 per cent of all coal Bottom ash is handled wet and disposed of as pond ash. Pond ash is potentially useable but variable in its characteristics because of its manner of disposal. To be environmentally sustainable, a concrete structure must be constructed in such a way that the total environmental impact during the entire life cycle, including use of the structure, is reduced to a minimum. They attempted a project study of bottom ash is combined with Portland cement, crushed limestone coarse aggregate, and water to produce concrete with a uniform slump of 100 mm # 4 mm. Four different mixes with cement content from (297 to 475 kg/m^3) are utilized. The engineering characteristics of mixtures made with bottom ash are compared with those of conventional concretes. This study includes fresh properties, hardened characteristics and long-term durability of bottom ash concrete [7]. have analysed the index and large-scale pavement facility testing of furnace bottom ash in the laboratory and outdoors. Normal tests are carried out on aggregate materials intended for sub base use The materials degradation under compaction, its self-cementing properties and is ability to carry traffic without excessive permanent deformation were studied. By comparison with other unconventional aggregates, which are used successfully in pavements, it would also appear to be satisfactory [12]. They have analysed the use of bottom ash presently formed at thermal power stations. It proves the effectiveness of comprehensive use of highly porous bottom ash as aggregate and fly ash as additive for production of lightweight concrete. Proportions, properties and conditions of producing normal weight concrete comprised fly ash were considered by a number of experiments. The main features of these concrete mixtures are a high content of water, resulting in two conditions: (a) absorptions of water by highly porous bottom ash particles; and (b) bonding the water to the fine fly ash particles. This research was concentrated on evaluating the effect of moisture content of the bottom ash on the lightweight concrete strength and the concrete mixture proportions.

II. EXPERIMENTAL INVESTIGATION

A. Materials

S.No.	Materials	Explanation
1	Cement	OPC 53 grade, Specific gravity = 3.14
2	Bottom Ash	Thermal power plant waste (Fly ash)
3	Fine Aggregate	Specific gravity = 2.66
4	Manufacturing Sand	M-sand is crushed aggregates produced from hard granite stone which is cubically shaped with grounded edges, washed and graded with consistency to be used as a substitute of river sand.
5	Coarse Aggregate	12 to 20 mm size

B. Methodology

The main focus of this experiment is to find the workability (slump cone test), 28 days cured compression strength (150mm cube) and split tensile strength (150mm diameter and 300mm height) of concrete made using hybrid combination of different materials as replacement. All the test are conducted as per IS code specifications. M20 grade of concrete is chosen as per the mix design calculation in IS10262. Mix ratio 1:2.57:3.09 and W/C ratio of 0.4 (128 kg/m^3). 20% of Bottom Ash is replaced for cement and 25%, 50%, 75%, 100% of manufacturing sand have een used has replacement simultaneously. The fresh concrete test is test is conducted for the amount of water content required for mixing with proper W/C ratio and compaction to avoid segregation and bleeding. The slump test is conducted.

Compression strength and split tensile strength conducted by placing the 28 days cured specimen after drying for 24 hours have been compressed using UTM.

C. *Mix Ratio*

S.No.	Cement (kg/m^3)	Bottom Ash (kg/m^3)	Fine Aggregate (kg/m^3)	M.Sand (kg/m^3)	Coarse Aggregate (kg/m^3)
M1	320	-	822	-	990
M2	256	64	822	-	990
M3	256	64	616.5	205.5	990
M4	256	64	411	411	990
M5	256	64	205.5	616.5	990
M6	256	64	-	822	990

III. RESULTS AND DISCUSSION

The following are the results of fresh concrete workability and 28 days cured specimens compressive strength and split tensile strength of harden concrete.

Mix Id	Slump, mm	Compressive Strength, N/mm^2	Split Tensile Strength, N/mm^2
M1	118	24.36	2.02
M2	126	23.42	1.86
M3	132	28.91	2.68
M4	136	31.12	3.23
M5	136	33.76	3.42
M6	138	22.63	2.10

From the results it is found that the workability of concrete increase when manufacturing sand content increases. Accordingly when Manufacturing sand increases up to 75% the strength of concrete increases beyond that when 100% replacement of fine aggregate replaced with manufacturing sand then the strength decreases. The optimum content of manufacturing sand with 20% bottom ash is found that as 75%. In Split tensile strength test the strength increases slightly when replacement of manufacturing sand for fine aggregate increases.

IV. CONCLUSION

From the experimental studies it is found that, workability varies when different percentage of components are added. Increase in M.Sand up to 75% increases the compressive strength and decreases when 100% is done. Split tensile strength increases and decreases gradually.

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