"Studies on Concrete by Replacing Certain Amount of Coarse Aggregate & Fine Aggregate with Kota Waste Stone"

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Abstract

In the view of reuse and recycling of waste, this project has been undertaken. This project aims at the effective use of stone waste. Concrete is highly used construction material with cement. Also, the demand for good quality of concrete is increasing because of fast – growing urbanization. Due to excessive utilization of these, it not only leads to depletion of natural resources but also has huge effect on the environmental balance in ways like water pollution, air pollution and even noise pollution. Besides these, while processing of layered slabs in quarries, lot of waste stone material is dumped along the sides of roads, which creates lot of nuisance and unhygienic atmosphere in nearby habitations.

In this research work, in production of concrete, constituent natural resources are replaced with Kota waste stone aggregates both for FA&CA in M25 grade concrete with 0, 25, 50, 75 and 100% and cement with fly ash up to 0,10 ,20 and 30% in 20 different mixes. The results have proven that 25% replacement has achieved highest strength.

Hence, this work can be used in the effective elimination of waste in Kota region if people use the stones in concrete.

Keywords: Concrete, Stone Waste, Kota waste Stones (KWS), Coarse Aggregates (CA), Kota waste stone aggregates, OPC 53 cement, Compressive Strength, Tensile Strength.

1. Introduction

Concrete is one of the most widely utilized material globally with total production of about 25 billion tons per annum. Its key ingredients are cement, fine aggregate, coarse aggregate, water and admixtures etc. with rapid surge in the growth rate of globalization and urbanization comes the insatiable demand for the raw materials in the concrete industry. As the demand for concrete is increasing time to time, different alternation materials were spotted for concrete production, taking into account for both environmental changes and future generation. On one side concrete is an essential and inevitable material for construction industry, but on the other side, a lot of non-renewable

exhausted gradually due to unlimited usage of concrete? As per calculations world consumes 5-7.5 billion tons of river sand every year for construction purpose. The excessive consumption of river sand has depleted the river beds and adversely affected the surrounding flora and fauna. The excessive mining of sand has resulted in reduced water storage of stream, lower water tables and unstable substructure of river bridges and eroded river beds. Thus, authorities in some countries had banned or constrained the usage of river sand as construction material. The limited supply of river sand on one hand and enhanced infrastructural development throughout the country has compelled the researchers and concrete manufacturers to look for other viable alternatives. The Rajasthan High Court also imposed ban on sand mining from river Banas in 2013, the ban was later lifted and provisional sanction was given due to sand requirement for ongoing Jaipur metro project [India times, 2015] but concrete is only one of the most common construction materials used in the building industry. Cement is the basic requirement for concrete which is required for all building and any other civil engineering constructions. The advancement in concrete technology is able to reduce the consumption of natural resources and energy sources and lessen the burden of pollutants, on the environment. More over the cost of natural resources also increased and reuse of natural resources by finding other alternatives.

Using fly ash in concrete, not only disposes huge stocks safely to avoid environmental pollution, but also acts as valuable resource to cement, in some extent without any initial cost. In addition to that, fly ash replacement in cement with optimum percentages improves workability, reduces permeability in concrete, reduce bleeding heat of hydration.

Researchers have assessed and tried to establish. The feasibility of a wide range of industrial waste products such as slag, pond ash, stone waste etc. as a substitute or partial replacement for fine aggregate and coarse aggregate in the concrete production. Keeping in view of the above circumstances, research work is conducted on Kota stone waste chips, which is available abundantly near Kota city, without any much initial cost. The research is primarily focused on replacement of all constituents of concrete with different mix combinations of Kota stone waste chips for both CA and FA and also with fly ash in cement.

2. Review of Literature

From the previous literature works, most of the authors conducted research only by replacing one or two constituents in the concrete. But in this research to replace all components with alternative materials. Concrete was produced in 20 different mix combinations by changing percentages of raw materials.

In this research study, Natural aggregate (CA&FA) are replaced by Kota waste stone aggregates in concrete production in 0, 25, 50, 75 & 100% and cement replaced by fly ash in 10, 20, 30% in 20 different mix combinations, to find out different properties of concrete like Compressive strength in cubes, Split tensile strength in cylinders.

G. Murali et al. [1] *studied the effects of shahbad (a variety of Kadapa) stone and the chemical Admixture (supaflo) on concrete by replacing with 10,20,30,40% and conclusion arrived that 30% replacement of Coarse aggregate has attained good strength in both cases.*

Prof. Jayesh Kumar Pitroda et al. [2] *has made study on feasibility of using thermal industry waste in concrete production with partial replacement of cement range of 0,10,20,30 and 40%in M25, M40 grade concrete and concludes that percentage of cement reduction, decreases the strength of concrete and also reducing the cost of concrete.*

Prof. Roshan Lal et al. [3] *has studied the strength characteristics of concrete by replacing with waste marble aggregates in natural aggregates and concludes that mix containing 20% and 30% waste marble aggregate increases the compressive strength at 28 days by 8.7% and 5.5% compared with control mix. Similarly with the same mix split tensile strength increased by 12% and 6% compared with control mix.*

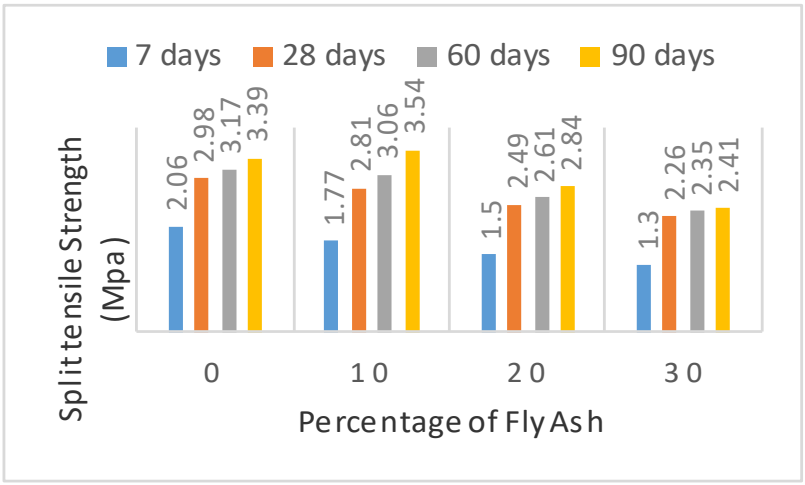
From the above literature it is observed that very few works have been taken place on other than hard broken granite (HBG). Hence in this view an experimental work has planned to study the effect of Kota waste stone (KWS) along with granite and also the fine aggregate is replaced by Kota Waste Stone Dust (KWSD). The work also emphasized to replace the cement by fly ash.

3. Material Used

CEMENT: In this research work, Ultra tech cement of OPC 53 grade was used for the experimental analysis. It was tested as per Indian standard specification and carried out specific gravity, setting time of cement, normal consistency, fineness of cement, compressive strength etc. Various tests results are mentioned in table 1

Mix Designations	Average Split Tensile strength in MPa			
	7 days	28 days	30 days	90 days
NAC-0-0	**2.31**	**3.20**	**3.48**	**3.78**
NAC-0-50	2.06	2.98	3.17	3.39
NAC-10-50	1.77	2.81	3.06	3.54
NAC-20-50	1.50	2.49	2.61	2.84
NAC-30-50	1.30	2.26	2.35	2.41

Table 5.2(c): Average Split Tensile strength (50% KWS)



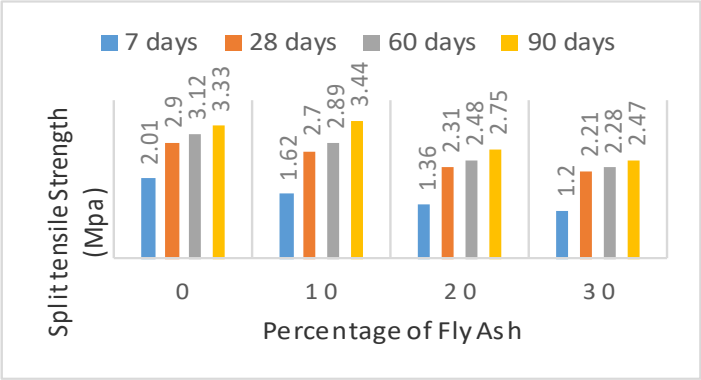
Graph 5.1(c): Average Split Tensile Strength v/s % of fly ash

[D] Average Split Tensile Strength of natural aggregate concrete cylinders (with 75% KWS) and fly ash replacement of (0, 10, 20, 30%)

The split tensile strength results for natural aggregate concrete (25%KWS) presented in Table 5.2(d) and graph 5.2(d) at the age of 7, 28, 60, 90 days. Maximum split tensile strength 3.44Mpa was observed for NAC-10-75 at 90 days. It is very clear [Table 5.2(d) and graph 5.2(d)] from the present experimental investigation.

Mix Designations	Average Split Tensile strength in MPa			
	7 days	28 days	30 days	90 days
NAC-0-0	**2.31**	**3.20**	**3.48**	**3.78**
NAC-0-100	2.01	2.90	3.12	3.33
NAC-10-100	1.62	2.70	2.89	3.44
NAC-20-100	1.36	2.31	2.48	2.75
NAC-30-100	1.20	2.21	2.28	2.47

Table 5.2(e): Average Split Tensile strength (100% KWS)



Graph 5.1(e): Average Split Tensile Strength v/s % of fly ash

DISCUSSIONS: From the results, it was found that replacement of 25% Kota waste stone with 10% fly ash at 90 days gives a very good result in all the tests conducted. Compressive strength showed a value of 52.58 N/mm^2 & Split Tensile strength showed a value of 3.41 N/mm^2. All these indicate that Kota stones can be effectively replaced instead of course aggregates and fine aggregate and good strength can be achieved.

RECOMMENDATIONS: This concrete mix of M25 with 25% replacement of course & fine aggregates using Kota waste has given an increase of Compressive strength & Tensile strength.

- This can be used in all places where M25 concrete can be used.
- This can also be used as a flooring material.

6. Conclusion

1. In the laboratory test water absorption found in natural granite is 0.125%, whereas Kota waste stone is 0.145% which is 0.02% more than natural granite aggregate.

2. It effects that as the percentage of Kota waste stone is increased in concrete mix, workability is reduced, simultaneously slump value also reduced.
3. As the alternative materials percentage is increased in the concrete mix, compressive strength and split tensile strength are reduced gradually.

6. Further Scope of Research

1. Flexure and shear strength studies can be permitted.
2. Durability tests can be evaluated.
3. Other supplementary materials (silica fume, rice husk ash etc.,) can be used to the same work.
4. Geo polymer concrete can be prepared with this KWS aggregate concrete and strength, durability studies can be conducted.
5. Temperature studies can be performed with these aggregates.

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