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A REVIEW PAPER ON STUDY OF EFFECT OF COARSE AGGREGATE SHAPE ON WORKABILITY AND COMPRESSIVE STRENGTH OF CEMENT CONCRETE IN RIGID PAVEMENTS

MEHR UN NISA[1], DR RAKESH GUPTA[2]

[1]M.Tech scholar (Highway Engineering), [2] Professor and Director Department of Civil Engineering
Shree Ram Mulkh Institute of Engineering & Technology, Kurukshetra University, Kurukshetra, India

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Abstract - *The importance of the form of aggregate particles on their mechanical behavior is well recognized. In recent years, various techniques are widely used to analyze the particle shape characteristics of aggregate and their effect on concrete properties. Some of the previous works which show that aggregate characteristics particularly shape has an important effect on concrete strength were reviewed in this paper.*

***Key terms*— Coarse aggregate, Cement Concrete, Compressive strength, Shape.**

1. INTRODUCTION

Aggregates are used in pavement construction in cement concrete, bituminous concrete, and other bituminous constructions and also as base-course underlying superior pavement layers. Therefore, the characteristics of coarse aggregate are of considerable importance in highway engineering. For a long time aggregate used in cement concrete was considered to be inert filler which is added to cement paste simply for economic reasons. However, this concept of property independence has not gone without challenges. Many studies have been made to determine the effect of the physical and chemical properties of coarse aggregate on the behavior of cement concrete. They include investigations into the effects of particle strength, surface texture, shape, and alkali reactivity. This paper brings together the findings and opinions found in the literature regarding the aggregate shape effect on concrete properties. An attempt is made to present all the important points of view.

2. LITERATURE REVIEW

Studies into the effect of aggregate particle shape upon the properties of concrete have been conducted for many years. As under some of the previous works done in this aspect are given below:

Kaplan. M. F. (1959) [1] studied the effects of the properties of 13 different coarse aggregates on the flexural and compressive strength of concrete. Statistical analysis indicated that the shape, surface texture, and modulus of elasticity of the aggregates were the main cause of variation in concrete strength. The greater the strength, the greater these factors became. The elastic modulus of the aggregate was in general the most important single factor affecting flexural strength, although, for concrete with greater strength, the surface texture had the predominating effect. The surface texture was the most important aggregate property influencing concrete compressive strength.

Shilstone (1990) [2] presented that aggregate shape has a major influence on concrete strength. In his study, it is shown that mixes containing spherical and equidimensional particle sizes have better pumpability and finishability, and produce higher strengths and lower shrinkage than mixes containing flat and elongated particles. He explains that slum may be controlled by gradation changes without adjusting the water-cement ratio. He added that for every combination of aggregate mixed with a given amount of cementitious materials and cast at a constant consistency, there is an optimum combination which can be cast at the lowest w/c and produce the highest strength.

Pedro. Nel. Quiroga and David. W. Fowler (2003) [3] based on the results from their study, it was found that the grading of aggregates affects significantly the performance of fresh mortar and concrete. To a lesser extent, they affect compressive strength and flexural strength when the stability of the mixture is compromised by poor grading leading to segregation or when concrete is difficult to place or to compact. The shape and texture of aggregates, cement, and supplementary cementing materials affect the packing density and consequently, they play an important role in the performance of fresh mortar and concrete. The effects of shape and texture as well as packing density of particles on mortar and concrete workability depend on the particle size, the smaller the particle the higher the effect on workability or water demand.

M. R. Vyawahare and P. O. Modani (2009) [4] from their investigation, it can be concluded that extremely flaky and elongated aggregate can also produce quality concrete which can be used for PCC work like Pavements, Factory floors, Foundations. With the W/C ratio of 0.4, a dose of super-plasticizer 0.80 and optimum powder content (Fly ash) 0.25 the concrete with any proportion of flaky and elongated aggregate replacing normal aggregate can produce workable concrete with acceptable strength. The 20% replacement of normal aggregate with flaky and elongated aggregate has

proved to be equally good as concrete made up with normal aggregate.

A. K. Jain, Dr. J. S. Chouhan (2011) [5] discussed from their study that shape characteristics of coarse aggregate must be taken into consideration to manufacturing pervious concrete to optimize its compressive strength and permeability. The aggregate of minimum possible angularity number and size, practically and economically available, shall be used to manufacture pervious concrete. An aggregate of desired angularity numbers may be manufactured to prepare pervious concrete.

M Markandeya Raju Ponnada (2014) [6] in his study M_{25} grade concrete was used for different ratios of weights of elongated, angular, and flanky aggregates and was tested for compressive strength, density, and workability. The results reveal that the effect of elongated aggregate is more than flanky aggregate on the characteristic compressive strength of concrete.

Himanshu Kumar et. al (2015) [7] this study was performed to evaluate the effect of the flaky and normal aggregates having different mix conditions on the compressive strength of cement concrete. Compressive strength was obtained higher for normal aggregate than flaky. Also, it was obvious that Compressive strength increases with the decrease in the size of the flakiness index for M_{15} and M_{20} grade of concrete. Also, the mixtures with rough aggregates have higher strength, especially tensile strength, at an early age than a corresponding concrete with smooth or naturally weathered aggregate.

B. V. R. Murthy et. al (2018) [8] investigated the effect of flaky aggregate on the workability and strength properties of concrete. The main aim of this study was to find the optimum percentage of flaky aggregate allowable in the concrete to obtain better workability and strength. From the experimental work, it is concluded that 20% of flaky aggregate is acceptable in the total coarse aggregate for getting better strength and workability. Hence the optimum percentage of flaky aggregate in the concrete is 20%. By the addition of admixture, the concrete with 20% of flaky aggregate also shows good improvement in compressive strength and workability.

3. METHODOLOGY

The methodology involved in the study is as follows:

1) Six different shapes of coarse aggregate were used namely elongated, flaky, elliptical, angular, blade, oval.
2) The size, shape, and surface texture were carefully controlled to reduce the number of variables inherently involved with this type of research.
3) Concrete cubes then prepared with these aggregate shapes and tested in compression to determine the relative strengths associated with the different coarse aggregate particle shapes.

4. OBJECTIVE

The main objectives of the study are:

1. Several authors have indicated the need for more research to determine the effect of aggregate particle shape on the properties of concrete.
2. The primary purpose of this study will be to evaluate the influence of different aggregate particle shapes upon the compressive Strength of concrete.
3. It is hoped that the results of this study will add to the general knowledge, and thereby aid in establishing a sound basis for the acceptance or rejection of concrete aggregates.
4. Another series of tests should be made in which the relative dimensions of the particles are varied. These tests would then provide a basis for the defined limits of particle shape.

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