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Influence of Diverse Aggregates on Concrete Characteristics

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Abstract - *The characteristics of ingredients used for performing construction will affect the performance of prepared concrete. Coarse and fine aggregates are major constituents of cement concrete when composed for preparing concrete for construction. Several researchers concluded from their experimental works that type of material used as coarse or fine aggregate significantly influence the strength and workability of concrete. In the present research, several studies performed by other researchers are reviewed in order to provide the information about variation of strength of concrete with different aggregates..*

Key Words: Aggregate, WAMs, flaky, workability. Coarse aggregate, fine aggregates, w/c ratio

1. INTRODUCTION

Cement, fine aggregate, coarse aggregate, and water are combined to create concrete. Its popularity is due to its versatility since it can be made to withstand harsh surroundings while yet taking on the most inspiring shapes. With the aid of innovative admixtures and other waste alternative materials, scientists and engineers are also seeking to increase its limitations (WAMs).

In the past, WAMs were made of easily accessible, natural materials like diatomaceous earth or volcanic ash. The Coliseum and Roman aqueducts are two examples of this technique utilised by the Romans and Greeks. The bulk of concrete mixtures nowadays are made up mostly of ACMs, which are waste products or byproducts of other industrial operations.

From the perspective of economy in cement requirement for given w/c ratio rounded aggregates are more preferred than angular aggregates. Flat particles in concrete are having unpleasant effect over the workability of concrete, cement requirement, strength and durability. In common high content of flaky aggregates formed low quality concrete.

The dimensions of aggregates and material used in place of coarse and fine aggregates are crucial characteristic, and these influences the basic characteristics of concrete such as strength and workability. Along with the shape of the aggregates, the texture of the coarse aggregate are also associated. Several researchers disagree with round aggregates due to bonding between aggregates and cement.

Fig 1 Rounded Aggreate

Fig 2 Angular Aggreate

2. ANGULAR AGGREGATES VS. ROUNDED AGGREGATES

The angular aggregates are better to rounded aggregates in the two circumstances –

1. Angular aggregates are more advanced in concrete used for roads and pavements due to indications of improved interlocking performance in the material.

2. For the specified amount, the total surface area of rough angular aggregate is greater than that of smooth spherical aggregates. Thus, angular aggregates showed stronger binding strength than rounder aggregates owing to their larger surface area.

The adhesion or bonding between cement paste and the aggregate has been subjected to several complex factors besides the physical and mechanical properties; this fact has been revealed by several researches and experiment. With the increase in smoothness of surface there is a decrease in contact area, hence a greatly refined and smooth particle will

have low bonding in terms of area in comparison with a rough particle of the same quantity. The qualities of aggregates directly affect the majority of the properties and workability of concrete, making them a critically important component. Formerly in the early stages of cement and concrete improvement, aggregates were considered inert when considered chemically and detained collectively by cement.

Recent evidence, however, indicates that the chemical link between the edges of aggregate and paste may be seen.

3. LITERATURE REVIEW

Muhit et al. (2013) for examining the properties of concrete due to dissimilar types of aggregates. Different shapes and casted aggregates have been combined and used to prepare different groups of concrete with variable water-cement (w/c). [1]

Jakarsi (2013) considered the results of laboratory tests for finding the effects of flaky dimensioned aggregates on characteristics of concrete. Marshall Mix Design has been used for estimating all the mix designs.[2]

Ryza et al. (2013), for understanding the significance of the shape of aggregates. In concrete, the shape of aggregate particles has been related to several properties such as reliability, slump or shear flow, resistance against shear, tensile and other behaviors. In recent years, Digital Image techniques have been conducted to find the particle shape characteristics of aggregate. [3]

Vyawahare and Modani (2009) a research was conducted to determine the permissible aggregate percentages in concrete mixes and to enhance the workability and strength of concrete containing flaky and elongated particles using superplasticizer and other admixtures.. [4]

Maslehuddin et al. [2003], conclusion that the resilience properties of steel slag cement concrete were better to those of crushed limestone aggregate concrete after comparing the features of steel slag and crushed limestone aggregate concretes. Concrete made of crushed lime stones had several physical qualities that were better. [5]

Westerholm et al. (2008) reported the findings of a laboratory examination into the rheological characteristics, including the yield stress and viscosity of the concrete. With the use of the appropriate tools, the effects of grading and sand particle form have been studied. The outcomes of the trials show how sand's amount and features affected the consistency and workability of mortar, among other properties. The amount of mortar is a key factor in determining how much the sand qualities affect. [6]

4. WORKABILITY OF CONCRETE

Workability of concrete mix prepared also influences the future condition of hardened concrete. Slump value determined has been related to the condition and compressive strength of hardened concrete structures.

5. COMPRESSIVE STRENGTH

The strength of plain, reinforced, and pre-stressed concrete, whether it is precast or cast in-situ, may be assessed using the compression test. The primary goals of the compression test are to look into -

• Anything which opposes compressive force

• The concrete's uniformity.

• The existence of flaws such as voids and fissures.

• Modifications to the concrete's structural integrity brought on by deterioration or wear that may develop over time.

• The concrete's quality in comparison to the stated criteria of the standards.

• The difference in quality between a concrete component's one and two components.

6. WAMS (WASTE ALTERNATE MATERIALS)

Strict environmental - pollution regulations and recommendations have recently led to an improvement in the industrialised wastes and subgraded derivatives that may be used as WAMs, such as silica fume, fly ash, ground granulated blast furnace slag (GGBFC), etc. The use of WAMs in concrete structures not only eliminates these pollutants-controlling materials but also enhances the properties of concrete in its hydrated and fresh stages.

Based on the kind of reaction, the WAMs may be divided into two classes: hydraulic and pozzolanic. To create cementations compounds like GGBS, hydraulic materials and water undergo a complete chemical reaction. When used with lime or cement, pozzolanic materials, which by themselves lack any cementation qualities, react with calcium hydroxide to produce compounds with cementation properties.

7. MARBLE POWDER AS WAMs

The creation of concrete technology may reduce the use of natural resources and energy sources as well as the amount of pollutants that are released into the atmosphere. Large amounts of marble dust are being created in natural stone processing facilities, which has an adverse effect on both the environment and people. Marble has been widely employed in the construction sector for a variety of applications, including flooring and wall cladding. One of the world's

atmospheric concerns is the industrial removal of marble powder material, which is in the form of a fine powder. Marble dust is deposited after being settled by sedimentation in India. Marble is a kind of metamorphic rock that evolved from pure limestone. The primary factor influencing marble's color and appearance is its purity. If the limestone is made entirely of calcite, it is white. Marble is in high demand because it is durable, has a noble look, and is used for both building and adornment.

Fig 3 Marble Dust

8. STEEL SLAG

In the process of separating molten steel from impurities in steel production furnaces, steel slag, a byproduct of the steel-making process, is created. These are suitable for use as aggregate in concrete. Because magnesium oxides and free lime are present in steel slag aggregate, which may hydrate and swell in damp environments despite not having yet interacted with the silicate structure, the material often exhibits a propensity to swell. This potentially expansive character (volume changes by 10% or more due to the hydration of calcium oxide and magnesium) may lead to complication with products like steel slag, which is one reason why steel slag aggregate is not utilised in concrete.

Fig 4 Steel Slag

9. Conclusions

A Various researches on varieties of aggregates have been discussed. Following are the significant findings of this paper:

•Several types of aggregates are available for making concrete but selection of any method is not an easy task.

•This paper provides basic information regarding type of aggregates, may be helpful for selection of suitable type of aggregates.

•Shape of aggregate particles has been related to several characteristics of concrete such as reliability, slump or shear flow, resistance against shear, tensile and other behaviors

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