

A Study on the Strength and Durability Characteristics of Concrete Using Fibres

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ABSTRACT: Concrete is the mostly utilized “man-made” material globally for construction in many developing countries in all types of civil engineering works. Also, concrete is an environmental friendly material and in areas of growing were attempted by the researchers to improve the quality, strength and durability against adverse exposures, since decades.

Concrete is a material used in civil engineering constructions, consisting of a hard, chemically inert particulate substance, known as an aggregate (usually made from different types of sand and stone), that is bonded together by cement and water.

I. INTRODUCTION

Rapid industrial development causes serious problems all over the world such as depletion of Natural Aggregates and it creates enormous amount of waste material from construction and demolition activities. On the other hand, river sand is another major problem. One of the way to reduce this problem is to utilize Demolished Coarse Aggregate (DCA), Demolished Fine aggregate (DFA), and Water and in the production of concrete.

In India, a huge quantity of construction and demolition wastes is produced every year. These waste materials need a large place to dump and hence the disposal of wastes has become a severe social and environmental problem. On the other hand scarcity of natural resources like river sand and wash water is another major problem which results in increasing the depth of river bed resulting in drafts and also changes in climatic conditions. Hence it becomes necessary to protect and preserve the natural resources. The possibility of Demolished Coarse Aggregate (DCA), Demolished Fine Aggregate (DFA), and Water in the construction industry thus increases the importance. In addition to the environmental benefits in reducing the demand of load for depositing the wastes, the Demolished Coarse Aggregate (DCA), Demolished Fine Aggregate (DFA), Water and can also help to conserve natural material Fine Aggregates to reduce the cost of waste treatment prior to disposal.

Demolishing of concrete is important it helps to promote sustainable development in the protection of natural resources, and reduces the disposal of demolition waste from the old concrete. Unprocessed DCA is useful to be applied as many types of general Bulk fill bank Protection, Sub – Basement, Road Construction, Noise Barriers and Embankments. Processed DCA can be applied to new concrete for Pavements, shoulders, median barriers, sidewalks, curbs and gutters, and bridge foundations. It can also be applied to Structural Grade Concrete, Soil-Cement Pavement Bases, Lean Concrete and Bituminous Concrete.

II. DEMOLISHED AGGREGATES

Demolished Aggregate is generally produced by two stages crushing of Demolished Concrete, screening and removal of contaminants such as reinforcement, wood, plastic etc. Concrete made with such aggregate is called as Demolished Coarse Aggregate (DCA) RILEM Committee 121-DRG has published.

Recommendations for the use of Demolished Aggregates, classifying them into two groups.

Group I - Aggregates mainly from Masonry Rubble

Group II - Aggregate obtained mainly from Concrete Rubble

Advantages of Demolished Aggregates:

1. Environmental Gain:

The major advantage is based on the environmental gain. Construction and demolition waste makes up to around 40% of the total waste each year (estimate around 14 million tons) going to land fill. Through recycled these material, it can keep diminishing the resources of Urban Aggregate. Therefore, Natural Aggregate can be used in higher grade applications.

2. Save Energy:

The recycling process can be done on site. A method of Demolishing crushed concrete that used in the construction, known as the "Within-Site Recycling System." Everything can be done on the construction site through this system, from the process of Demolishing Coarse Aggregate, manufacture and use them. This can save energy to transport the demolished materials to the recycling plants.

3. Cost:

Secondly is based on the cost. The cost of Demolished Coarse Aggregate is cheaper than the Aggregate available in market. It depends on the aggregate size limitation and local availability. This is just around one and half of the cost for natural aggregate that used in the construction works. The transportation cost for the Demolishing Coarse Aggregate is reduced due to the weight of Demolishing Coarse Aggregate is lighter than aggregate.

4. Job Opportunities:

There will be many people involved in this new technology, such as Specialized and Skilled Persons, Masonry etc.

5. Sustainability:

The amount of waste materials used for landfill will be reducing through usage of Demolished Coarse Aggregate. This will reduce the amount of Quarrying. Therefore this will extend the lives of Natural resources.

➤ **Disadvantages of Demolished Aggregates:**

1. Hard to have permit:

It is hard to get the permit for the machinery that needed air permit or permit to operate during the DCA process. These has to depend on the local or state regulations whether this technology is implemented or not.

2. Lack of Specification and Guidelines:

There is no specification or any guideline when using Demolished Coarse Aggregate in the constructions. In many cases, the strength characteristic will not meet the requirement when using Demolished Coarse Aggregate.

III. HISTORY OF FIBER REINFORCED CONCRETE (FRC):

Fiber reinforced concrete (FRC) may be defined as a composite materials made with Portland cement, aggregate and incorporating discrete discontinuous fibers. The real contribution of the fibers is to increase the toughness of the concrete (defined as some function of the area under the load vs. deflection curve), under any type of loading. That is, the fibers tend to increase the strain at peak load, and provide a great deal of energy.

The type of fibers that is used in the FRC are of two types. They are

1. Natural fibers,
2. Artificial fibers.
- 3.

1.3.1 NATURAL FIBERS

The fibers which are extracted from the natural resources are called natural fibers. Following are some types of natural fibers

1. Sisal
2. Coir
3. Bamboo
4. Jute
5. Akwara
6. Elephant Grass

1.3.2. ARTIFICIAL OR SYNTHETIC FIBERS

The fibers which are manufactured from the man made sources are called artificial fibers. Some of the natural fibers are

- Steel fibers

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- Glass fibers
- Polymer fibers
- Polypropylene fibers

WHY USE OF FIBERS IN CONCRETE?

Synthetic fibers benefit the concrete in both the plastic and hardened concrete. Some of the benefits include

- Reduces plastic settlement cracks
- Reduces plastic shrinkage cracks
- Reduces permeability
- Increases impact and abrasion resistance
- Provides shatter resistance

ADVANTAGES OF FRC:

Use of fibers in the concrete benefits the following

- Improve ductility
- Reduce crack widths and control the crack widths tightly thus improve durability
- Improve impact & abrasion resistance
- Improve freeze-thaw resistance
-

DISADVANTAGES OF FRC:

The main disadvantage associated with the fiber reinforced concrete is fabrication. The process of incorporating fibers into the cement matrix is labor intensive and costlier than the production of the plain concrete. The real advantages gained by the use of FRC overrides this disadvantage. It may be economically high cost to use fibers in the case of large constructions.

FIBER REINFORCED CONCRETE

Fiber reinforced concrete (FRC) was introduced commercially into the European market in the second half of the 1970's. No standards or recommendations were available at that time which was a major obstacle for the acceptance of this new technology. Initially steel fibers were mostly used as a substitute for secondary reinforcement or for crack control in less critical parts of the construction. Today steel fibers are widely used as the main and unique reinforcing for industrial floor slabs. They are also considered for structural purposes in reinforcement of slabs on piles, full replacement of the standard reinforcing cage for tunnel segments, concrete cellars, foundation slabs and shear reinforcement in prestressed element.

FIBERS USED IN THE PROJECT

1. STEEL FIBERS
2. POLYPROPYLENE FIBERS

IV. CONCLUSIONS

- Concrete compressive strength mainly depends upon the quality of Demolished Coarse Aggregates.
- Water absorption depends upon the quantity of Demolished Coarse Aggregates i.e. for fresh concrete it is 0.5 and for Demolished Coarse Aggregates it is 1.2.
- By previous records concrete with more than 50 percent replacement of Demolished Coarse Aggregates has significantly more shrinkage compared to nominal mix.
- The properties of concrete such as modulus of elasticity and shrinkage deformation are lower for Demolished Coarse Aggregates compared to nominal mix.
- So this Demolished are not recommended for a structure of large deformations.
- In developing countries like India it is very difficult to dispose this demolished waste because it causes different environmental problems.
- So by this project it is proved that Demolished Aggregates is used in normal concrete practices.
- By the use Demolished Coarse Aggregates we can reduce cost.
- And this Demolished Coarse Aggregates is eco-friendly.
- The scarcity of aggregates can also be reduced.
- The workability of concrete with Normal and Demolished Coarse Aggregates is almost same
- I also conclude that the demolition aggregates can be used for the manufacture of high strength concrete if they are efficiently designed and mixed.

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- By observing the done project, I can conclude that the reuse of the demolished aggregates reduces the waste on the land and it helps for the growth of green environment
- The present project mainly predicts that the demolition aggregates can be safely used in high strength concrete by adding synthetic fibers.
- The addition of polypropylene fibres reduces the flow characteristics and workability of the concrete mixture; however it also reduces bleeding and Segregation in the concrete mixture.
- The mixing, placing, finishing and consolidation of the Polypropylene fibre reinforced concrete (PPFRC) needs careful attention and control as the Performance of PPFRC is greatly affected by these.
- The polypropylene fibers (PPF) reduce early age shrinkage and moisture loss of the concrete mix even when low volume fractions of PPF are used.
- Addition of the polypropylene fibers (PPF) has little or insignificant effect on the compressive strength of plain concrete.
- Addition of the polypropylene fibers (PPF) increases the deformation capacity of concrete (in compression) and thus improves the material ductility of concrete.

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