

# Studies on Concrete Made of Recycled Materials for Sustainability

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## ABSTRACT

The importance of recycled materials incorporate as building products is becoming more than ever before. Materials recycled and used as concrete mixtures decreases the depletion of natural and raw virgin materials. Research was on the basis to investigate the amount to variation on properties due to using the recycled materials. The recycled material mainly consists of: Recycled concrete aggregate (RCA) Crushed waste glass. Granulated blast furnace slag. The use of granulated blast furnace slag was as cement replacement. The glass crushed and recycled concrete aggregate were used as coarse and fine aggregate replacement. Then recycled concrete material was compared with the one having standard concrete mixture. Recycled materials as compared to the fresh concrete have very low permeability. Air content was about 7%. Some positive effect and negative effect as well were investigated of using recycled material as concrete material.

Application in general purpose without any process.

- The protection of Bank.
- Construction of Road
- Drainage structure base and fills
- Many types of bulk fills

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## INTRODUCTION

### Mix Design

Generally, without affecting any mechanical properties of concrete upto 25% of the natural coarse crushed aggregate can be replaced easily by recycled coarse aggregate. The effect of increase in the amount of replacement are creep in the concrete will increase and drying density will also increase. However, modulus of elasticity will decrease along with the tensile strength. And the properties like freeze – thaw resistance and strength in compression are not affected significantly.

### Sustainability

In several different ways sustainability is provided by recycling concrete.

The amount of material that must be land filled is reduced by simple act of recycling the concrete.

This also reduces the economic impact of the construction project.

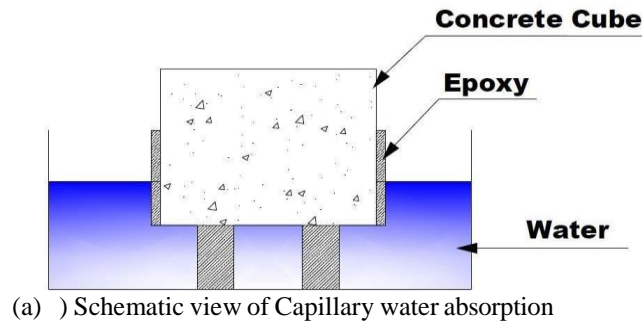
As we know using recycled concrete aggregate decrease the need for virgin aggregate which in turns generally reduces the bad environmental impact of the aggregate extraction process.

### Study Of Waste Plastic Mix Concrete With Plasticizer

Sand was partially replaced by the waste plastic flakes in a number of concrete mixes in varying of volume. At room temperature this plastic waste mix concrete with and without super plasticizer were tested. Cube samples were moulded for the compressive tests in 3, 7, & 28 days. Beams with the mix were also designed to study the flexural strength characteristics. The results were reduction in compressive strength and also reduction of workability due to replacement of sand partially by waste plastic.

### Resource management aspect

A large amount of carbon dioxide from the environment surroundings is absorbed by the recycled concrete aggregates.



Recycled aggregate are more porous and absorptive than many of the natural aggregate as it contains mortar from original concrete.

Coarse recycled aggregate Water absorption-  
4-6 %

Fine recycled aggregate water absorption 8-10% Natural aggregate 1-3%  
absorption.

### Fresh Density

The fresh density below the reference mixtures, that is, 0% tends to decrease by 5.2%, 8%, and 10.57 % for 5%, 10%, and 15%, respectively; the trend may be attributed to density of the waste plastic used in mix being lower than sand by seventy percent (70%), which in results leads to reduction in the fresh density.

## RECYCLED-AGGREGATE CONCRETE

### Feasibility and sustainability

Recycled-aggregate concrete (RAC) can be used for structural prepared by completely substituting normal aggregate, to achieve almost the same strength and class as the reference concrete, contrived by using only natural aggregates. Obviously, this is a provocation, since recycled aggregates of large scale to allow for the full substitution of normal aggregates is not available at all. However, to prove that to manufacture concrete structure by partly substituting normal with recycled aggregates is useful by up to 50% is indeed feasible. If the adoption in any case a very low water to cement ratio implies weakly high amounts of cement in that concrete mixture, Recycled aggregate concrete can also be made by using a water Reducing admixture so as to lower both the water and cement dosage, or by adding fly ash as partial replacement to fine aggregate and also by using superplasticizer to achieve the required workability.

### Technical improvement

When the concrete, in addition to good cohesiveness shows high fluidity, the concrete is said to be self-compacting. The recent achievements in concrete technology, has lead to several many advantages, is in fact a development of well-known Rheo-plastic concrete , achievement with the super plasticizers, in which bleeding and segregation are covered up by a filler addition and by using a viscosity modifying agent with it. Though, these added extras might not be sufficient, if maximum volume of coarse aggregate and minimum volume of fine particles (including cement, limestone, fly ash and other similar materials) are not complied with. Additionally, from rheological tests with cement pastes, it has been seen that, for highest segregation resistance, the yield stress should be high of the paste and differences in the density between the paste and the aggregate should be low.

### Durability

Durability aspects related to that recycle aggregate concretes have been studied. Attention has been focused particularly on the influence of porosity of concrete on shrinkage drying and corroded embedded steel bars as well as on carbonation concrete, concrete resistance to freezing and thawing cycles and chloride ion penetration. Observations showed that, if fly ash is added to recycled-aggregate concrete:

1. There is improvement in pore structure.
2. And particularly reduction in macro pore volume which cause benefits in mechanical performance, such as tensile, compressive and also the bond strength. As compared to ordinary concrete prepared with normal aggregate, the only difference is reduced stiffness a little of the recycle aggregate concrete which contains fly ash, that should be kept in mind during structural design.
3. The drying shrinkage of concrete with recycled aggregate, from the serviceability point, does not seem to be a problem, due to the decreased stiffness of concrete, the risk of crack development outcome same as for ordinary concrete under

restrained conditions

4. The testing of concrete resistance property against freezing and thawing cycle's shows no variation between normal aggregate concrete and sky-scraping amount fly ash recycle aggregate concretes.

### **Economical evaluation**

As in most strength class value of 30 MPa is required for common structural applications, if a recycle aggregate concrete without any additive mineral might not perform suitably, whereas recycle aggregate concrete having fly ash in high-volume would have outstanding performance. For this result an economical comparison is supposed to be made for counterpart performances between natural aggregate concretes and that recycled aggregate concrete having high-volume fly ash of the same strength class. On the source of current individual costs of those constituents, long-established costs evaluation can be approved out leading to the cost of that high volume fly ash recycle aggregate concrete being somewhat higher (about five percent) than normal aggregate concrete. Materials and Mixture Proportion

### **The RECYCLED COARSE AGGREGATE**

Samples were collected from 2 source recycled concretes:

(a) The demolished concrete wall not used and constructed for the drainage purpose (3 years old) and

(b) The Crushed concrete beams and cubes from structural engineering laboratory about zero to one year old.

While the Source Can be considered as non-load-bearing type with a design characteristic strength with of 20 MPa the Source concrete was a mixture of concrete with different design quality strength ranging from about 25 MPa to 30 MPa and all of them were undergone a loading in direct compression or combined shear bending up to the failure. The conclusion condition for both of the sources may be considered as normal.

### **Air Content**

Air entrainment is one of the compulsory components of the concrete mixtures exposed to the freezing and thawing environments. The measurements of the air content in a fresh concrete of normal density is typically performed using the pressure method. It can be seen that the air content of RECYCLED CONCRETE 2 concrete at the fresh condition is slightly higher than that of RECYCLED CONCRETE 1 concrete. The more air content in the RECYCLED CONCRETE 2 concrete may be due to more amount of adhered old mortar on the surface of RECYCLED CONCRETE 2 aggregates. The N-2 RECYCLED CONCRETE 1 concrete also show more air content than RECYCLED CONCRETE 1 due to the equal reasons.

### **Materials and Test Specimens**

The experimental results of concrete made of PSC partially replaced with SF and FA is explained here. The description of ingredient materials used in the present study and the details of different test specimens is explained here. According to ASTM C 1240 Chemical composition of SF is analyzed. According to the relevant Indian Standards, cement and SF used in the experiment are tested.

### **Concrete using SF**

The behavior of concrete made of PSC cement partially replaced by SF is studied in first part of this chapter. Seven sets of concrete mixes are prepared by partial replacement of cement with equal weight of SF. Mix designs are prepared as per Indian Standard IS:10262-2009 and weight proportions of cement, SF, natural sand, coarse aggregates, water and admixture.

### **Dosage of SF and ability of Concrete**

Because of very high specific surface area of SF workability of SF concrete reduces gradually. Super plasticizer adding is required for SF concrete to gain desired workability. Dose of super plasticizer should increase with the increase of SF dosage to maintain the slump value within a range. Slump test is conducted on fresh concrete for all the concrete mixers.

### **Tensile Splitting Strength**

Tensile splitting strength of FA concrete is obtainable in Fig. 4.14. This picture shows that FA reduces the tensile splitting strength of concrete. However, the reduction of tensile splitting strength is established to be negligible up to 20% of FA substitution.

### **Flexural Strength**

Flexural strength of FA concrete for various amount of FA is accessible in Fig. 4.15. It can be seen in this figure that up to 20% of FA substitute made no variation in flexural strength compared to the manage the specimen. Further increase of FA found to decrease the flexural strength of concrete gradually.

## CONCLUSIONS

The investigational study is carried out to learn the enhancement of properties such as compressive strength, tensile splitting strength and flexural strength of concrete of PSC having SF and FA. The most important conclusions of the present revision are as follows:

1. Universal behavior of medium grade PSC concrete partially replaced with SF is originate to be similar to that of Portland cement concrete as reported in previous literature. Incorporation of SF is found to be rising the compressive, tensile split and flexural strength of concrete of PSC.
2. The compressive strength of concrete rises slowly from a SF dosage of 5%, to arrive at the best value at 20%. The percentage of addition in strength is experiential to be about 29%, 40%, 59% and 44%, for the corresponding SF amount of 10%, 15%, 20% and 25% respectively. A cap of about 21% in contrast with earlier researches is found at 20% substitute. This cap can be accredited to use the 10% extra cement.
3. The split strength of concrete cylinders increases gradually with the SF dosages to reach an optimum value at 20%. When compared with earlier researches, it is set up that the rise of strength is lower at lesser amount of SF but it is like at higher dosages of SF.

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