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Study of Strength Characteristics for Concrete Block using Waste Plastic

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ABSTRACT

Disposal of large quantity of Plastic waste has emerged as an important environmental challenge, and its recycling is facing a big problem due to non-degradable nature. Due to Plastic does not decompose biologically; the amount of Plastic waste in our surroundings is steadily increasing. The proposed concrete blocks which are made up by adding Plastic waste in Fibre and granular form in concrete blocks may help to reuse the Plastic waste as one of the additives material of blocks, and to help the disposal problem of Plastic waste.

The objective of the study was to determine and compare the differences in properties of concrete block containing no Plastic waste and concrete block with Plastic waste in Fibre and granules form, as well as the comparison on the effects of different volume of Plastic waste to the concrete block. This investigation was carried out using several tests, which included compressive strength, water absorption, density, soundness, size and shape and hardness.

The properties of concrete blocks which contain varying percentages of Plastic waste (1%, 1.5%, and 2%) tested for compressive strength, water absorption, density, soundness, size and shape and hardness. It shows that an appreciable improvement in the performance of blocks can be achieved by introducing granular type of Plastic waste in to concrete blocks. In view of utilization of Plastic waste material for developing sustainable construction material, the present paper reviews Plastic waste materials in different compositions of 1% to 2% that were added to the raw material to develop Plastic waste concrete blocks. The compression strength of the blocks is reviewed and recommendations are suggested as the outcome of the study. The 1% Granular Plastic block showed excellent performance in all the tests performed.

Keywords: Plastic Waste, Compressive Strength, Water Absorption, Environmental Issue, Granular Plastic Block.

INTRODUCTION

Concrete blocks were first commercially manufactured in the United States in 1897 (Bell, 1970, p. 3). These blocks were inexpensive substitutes for quarried stone and clay masonry products (structural tile and brick). Although concrete blocks are currently used in virtually all types of construction, most blocks are used in the walls (exterior and interior), floors, and foundations of various types of buildings. Concrete blocks come in many different sizes and shapes. However, the eight inch by eight inch by sixteen inch block is the most versatile and common unit.

Cement concrete blocks have an important place in modern building industry. They are cost effective and better alternative to burnt clay bricks by virtue of their good durability, fire resistance, partial resistance to sound, thermal insulation, small dead load and high speed of construction. Concrete blocks being usually larger in size than the normal clay building bricks and less mortar is required, faster construction is achieved. Also building construction with cement concrete blocks provides facility for concealing electrical conduit, water and sewer pipes wherever so desired and requires less plastering.

Plastic is one of the most significant innovations of 20th century material. The amount of Plastic consumed annually has been growing steadily and becomes a serious environmental problem. For solving the disposal of large amount of recycled Plastic material, use of Plastic in modern building industry is considered as feasible application.

Concrete blocks volume contains 65–80% aggregate and it plays a substantial role in concrete blocks properties such as workability, strength, dimensional stability, and durability, so the use of waste materials in concrete blocks as partial replacement of aggregates can affect in the amount of waste materials deeply. Lightweight aggregate is an important material in reducing the unit weight of concrete blocks. A work has already been done on the use of Plastic waste as polypropylene(P.P.) such as Lightweight aggregates.

Concrete is a basic material for civil engineering construction. All basic ingredients of concrete are natural. But the properties of concrete can be change by adding some Plastic Fibre and Granules. The concrete has many advantageous properties such as good compressive strength, durability, specific gravity and fire resistance but tensile strength of the concrete is very much of low means that it can be neglected. But tensile property and

Flexural Strength of the concrete can be increased by the addition of Plastic Fibre. Research conducted for the utilization of Plastic waste and mixing them in the concrete by taking some aspect ratio.

Plastic increases substantially, all over the world which leads to create large quantities of Plastic-based waste. Plastic waste is the one of the challenge to dispose and manage as it is non biodegradable material which is harmful to our beautiful environment. The polypropylene(P.P.) are recycled and used in concrete. This study aims at examining the effect of recycled Plastic in concrete as aggregates for the impact resistance, by better understanding the behavior of recycled Plastic in concrete structures, experimenting fresh and hardened concrete mixtures containing recycled Plastic.

OBJECTIVE AND AIM OF THE PROJECT

We are the part of environment and it is our prime responsibility towards the society to protect it. We would be fortunate to be a part of such a project which helps us to make our environment more sustainable. So, if we make use of Plastic as construction material then we would have an alternative to reduce the Plastic and we can conserve natural resources used for construction.

Aim

1. To minimize Plastic waste from environment and society.
2. To develop an alternative for the traditional way of construction.
3. Plastic is non-degradable waste in environment and hence only reuse of Plastic is the best way to dispose it off effectively.
4. To conserve natural resources for the future need.
5. Reducing the cost of bricks for construction to make them cheaply available.

Objectives

The main objectives of this research proposal are to evaluate the possibility of using full water bottle and granulated Plastic waste materials. The following were also proposed

1. Check the compression strength of concrete block when Plastic waste can be used as core part of concrete block.
2. As partial substitute for the fine aggregate in concrete composites.
3. To investigate the mechanical behavior of the components by using Fibres.
4. To determine the percentage of Plastic Fibre and granular which gives more strength when compared to control concrete.
5. It is counted as one of the foundations for green project through reduces land and air pollution

LITERATURE REVIEW

Al-Manaseer and Dalal, (1997) investigated the effect of Plastic aggregates on the bulk density of concrete. For this purpose, they made 12 concrete mixes with different w/c containing varying percentages (0%, 10%, 30%, and 50%) of Plastic aggregates. Angular post-consumer Plastic aggregates having a maximum size of 13 mm were used. They concluded that: (i) bulk density of concrete decreased with the increase in Plastic aggregates content; (ii) reduction in bulk density was directly proportional to the Plastic aggregates content; and (iii) density of concrete was reduced by 2.5%, 6%, and 13% for concrete containing 10%, 30%, and 50% Plastic aggregates, respectively. Reduction in density was attributed to the lower unit weight of the Plastics.

Marzouk et al. (2007) reported the bulk density of cement mortar mixes prepared by replacing 0– 100% in volume of sand by two different sizes of PET aggregates. Their results showed that the reduction of bulk density remained small when the volume occupied by aggregates varies between 0% and 30%, regardless of their size. However, when this volume exceeded 50%, the composite bulk densities started to decrease until reaching a value 1000 kg/ m3. They also found that for the same volumetric percentage of substitution the bulk density decreased with decreasing particle size.

Ismail and Al-Hashmi,(2008) presented the possibility of using various Plastic wastes, containing approximately 80% polyethylene and 20% polystyrene, as fine aggregates, up to 4.75 mm in concrete. By increasing the Plastic waste content, the compressive tests showed the tendency for compressive strength values of Plastic waste concrete to decrease below the reference concrete at each curing age. The concrete with 10% of Plastic waste displayed the lowest compressive strength at 28 days curing age, about 30% lower than that of the reference concrete mixture. Also the study found 5%, 7%, and 8.7% lower densities of concrete mix containing 10%, 15%, and 20% Plastic aggregates respectively.

Choiet al. (2005) studied the effects of polyethylene terephthalate (PET) bottles lightweight aggregate (WPLA) on the density of concrete. Mixture proportions of concrete were planned so that the water/cement ratios were 45%, 49%, and 53%, and the replacement ratios of WPLA were 0%, 25%, 50%, and 75% by volume of fine aggregate. Density of concrete mixtures decreased with the increase in WPLA content. In their study the influence of polyethylene terephthalate (PET) bottles lightweight aggregate (WPLA) on the splitting tensile strength of concrete was observed. Mixture proportions of concrete were planned. The water/cement they concluded that: (i) splitting tensile strength of concrete mixtures decreased by 19%, 31%, and 54% with the increase in PET aggregates by 25%, 50%, and 75% respectively; and (ii) for a particular PET aggregate content, splitting tensile strength increased with the reduction in w/cm ratio. Also the study investigated the effect of polyethylene terephthalate (PET) bottles lightweight aggregate (WPLA) on the modulus of elasticity of concrete. According to the authors, modulus of elasticity of concrete mixtures decreased with the increase in PET aggregates.

METHODOLOGY

Cement Concrete Blocks:

Prepare the concrete mix

Get a large container, as large as we can get in our area. We will require cement, sand, gravel, and water for making the concrete mix. Put the cement, sand, and gravel in the container at a ratio of 1:4:8. Start mixing water in the container and stir the mixture continuously with a rod. Pour water until the concrete mixture become pliable enough to pour in the mold.

Making the raw concrete block:

Pour the concrete mixture in to the mold, and stir or vibrate the mold so that the concrete gets settled in the mold and reaches the extreme corners. Scoop the excess concrete mixture using a plywood plank at the open face of the mold. Level the open surface smooth by running the plywood plank across it, as our blocks are made in the machine (Automatic Concrete Block making machine) so the above manual steps can be skipped and only the materials can be added forming into the batch and the rest procedure can be adopted as explained above.

Curing& Drying:

The concrete block is to be kept in the mold for 24 hours for drying. Then remove the concrete block from the mold and put it in a water tank for curing, for 7 and 28 days,The curing process will provide the required compressive strength and will take around two weeks. At 7 days it achieves 70% strength of concrete and at 28 days it achieves 100% strength of concrete after curing some moisture is present in that concrete block so we are drying them for 7 to 14 days.

Figure 1: Cement Concrete Blocks.

FUTURE SCOPE

Further investigations can be carried out to understand more mechanical properties of waste Plastic Granules and Fibers to be used in Concrete Blocks. Several recommendations for further studies are mentioned below:

1. Introducing Plastic waste in some other form rather than Granules and Fibers like powder form, molten form, angular chips, etc. and then comparing their Results.

2. The Heat of Hydration can be reduced by adopting various techniques such as using cold water for mixing purpose, addition of fly ash and admixtures, avoiding casting during the high temperatures.

3. Use of additives to obtain smooth surface and to obtain proper mixing by increasing cement plastic bond.

4. One can use the higher percentages of plastic for the partial replacement of sand to obtain the optimum percentage of plastic to be replaced.

5. More investigations and laboratory tests can be done to study on the mechanical properties of waste plastic Granules and Fibres. Such applications of Granules and Fibres can be done in testing on concrete slabs, beams and walls or conducting more tests such as abrasion, impact, blasting, shatter, shear or creeping of concrete.

6. The cost of waste plastic Granular Block can be reduced if its production is carried out on large scale and hence would stand out to be more economical as compared to the Standard Concrete Block.

CONCLUSION

1. The Compressive Strength of Plastic Granular Concrete Block was observed to be higher than the Compressive Strength of Standard Concrete Block and Plastic Granules &Fibre mix Concrete Block.

2. The Compressive Strength of Plastic Granular Concrete Block was found to increased after replacing the % of crush sand partially with the % of Plastic Granules (P.P. Plastic).

3. It was observed that by replacing the crush sand with lower % by volume of plastic Granules (P.P.) gives good Compressive Strength in concrete Block.

4. The Water Absorption % in Plastic Granular Concrete Block was observed to be higher than the Water Absorption % in Plastic Granules and Fibre mix Concrete Block.

5. Lower the % of Granules higher is the Water Absorption % in the concrete block.

6. The Density of Plastic Granular Concrete Block was found to be higher, than the Density of Plastic Granules &Fibre mix Concrete Block.

7. The Granular Concrete Block was observed to have lower air voids than the Plastic Granules and Fibre mix Concrete Block hence, density of blocks with lower % of replacement was found to be high.

8. All the blocks were of perfect Shape and size.

9. Blocks when Stroked with each other, gave clear bell ringing sound which indicated that, the blocks had achieved the good strength.

10. Our Waste plastic blocks can be the best alternatives to Traditional Bricks.

11. Economical on large scale basis.

12. Decrease in Disposal problems of waste plastic.

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