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Behaviour of Polypropylene Fibre Reinforced Concrete with Artificial Sand

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Abstract**—** *The paper presents review of research work on behaviour of Polypropylene fibre reinforced concrete and concrete with artificial sand. A brief summary of the most significant investigations on the behaviour of concrete by replacing natural sand with artificial sand also natural sand with polypropylene fibre reinforced concrete. Various fibres are available in practice, but generally fibre which are stronger and more ductile than concrete are used in fibre reinforced concrete. Which help to arrest cracking and transfer the tensile load across the crack to achieve this effect sufficient bonding between fibre and concrete is required. Polypropylene monofilament fabricated fibres serve the purpose with 0.4% to 1.5 % of cement. And natural sand will replaced by artificial sand with different percentage such as 20,40,60,80 and 100 percent due to which environmental and social problems arise due to acute shortage of natural sand will be overcome.*

Keywords*—Polypropylene fibre, Artificial sand, Compressive strength, Workability*

I. INTRODUCTION

We cannot imagine the structures without concrete. Concrete is a main constituent of the Civil Engineering structures. It is becoming the backbone of infrastructural development of whole world. Concrete has capacity to enhance its properties with the help of other suitable constituents.

The main disadvantages of concrete are as follows -

- Brittleness
- Very low tensile strength
- Less resistance to cracking
- Heavy mass (density)
- Plastic and drying shrinkage.
- Permeability and bleeding of water

Approximately 80% of total volume of concrete is made up of aggregates. Aggregates characteristics (size, shape, texture, grading) influence the workability, finish ability, bleeding, and segregation of fresh concrete and durability of hardened concrete. Fine aggregates may be one of the following types; Natural sand, crushing natural gravels, crushing hard stones (artificial sand).

With natural sand deposits the world over drying up, there is an acute need for a product that matches the properties of natural sand in concrete. In the last 15 years, it has become clear that the availability of good quality natural sand is decreasing. With a few local exceptions, it seems to be a global trend. Existing natural sand deposits are being emptied at the same rate as urbanization and new deposits are located either underground, too close to already built-up areas or too far away from the areas where it is needed, that is, the towns and cities where the manufacturers of concrete are located. Environmental concerns are also being raised against uncontrolled extraction of natural sand. The arguments are mostly in regards to protecting riverbeds against erosion and the importance of having natural sand as a filter for ground water. The above concerns, combined with issues of preserving areas of beauty, recreational value and biodiversity, are an integral part of the process of most local government agencies granting permission to aggregate producers across the world. This is the situation for the construction industry today and most will agree that it will not change dramatically in the foreseeable future.

Some remedial measures can be taken to minimize some bitter properties of concrete. From centuries, mankind has used the different fibre for various types of application including building materials. In most of the countries, users have explored the possibilities of using the different fibres Due to the light weight, high strength to weight ratio, corrosion resistance and other advantages, polypropylene fibre based composites are becoming important composite materials in building and civil engineering fields. Concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres that are uniformly distributed and randomly oriented. In this study the attempt has been made to replace natural sand by artificial sand. i.e. the fine aggregates produced by crushing hard stone in the plain concrete. Also to study use of polypropylene fibre with different weight and different length procured from M/s Tashi India Ltd. Nagpur in different mixed proportions. The advantages of polypropylene fibre are as belows:

- Inhibits Plastic Shrinkage Cracks
- Inhibits Settlement Cracks
- Increases Tensile Strength
- Prevents Spalling
- Increases Flexural Strength
- Provides Impact Resistance
- Increases Fatigue Resistance
- Provides Abrasion Resistance
- Increases Overall Durability & Anti - Crack Strength
- Increases Toughness

II. REVIEW OF LITERATURE:

The consumption of cement content, workability, compressive strength and cost of concrete made with Quarry Rock Dust were studied by researchers Babu K.K.et.al , Nagaraj T.S.et.al, and Narasimahan et.al. The mix design proposed by Nagaraj et.al shows the possibilities of ensuring the workability by wise combination of rock dust and sand, use of super plasticizer and optimum water content using generalized lyse Rule.

M. R. Chitlange in 2010 study shows that mixes with artificial sand as fine aggregate gives consistently higher strength than the mixes with natural sand. The sharp edges of the particles in artificial sand provide better bond with cement than the rounded particles of natural sand resulting in higher strength. The excessive bleeding of concrete is reduced by using artificial sand.

R. Ilangovana1, N. Mahendrana1 and K. Nagamanib2 states that the Physical and chemical properties of quarry rock dust is satisfied the requirements of code provision in properties studies. Natural river sand, if replaced by hundred percent Quarry Rock Dust from quarries, may some times give equal or better than the reference concrete made with Natural Sand, in terms of compressive and flexural strength studies

Priyanka A. Jadhava and Dilip K. Kulkarni The effect of concrete with partial replacement of manufactured sand on the properties of normal strength concrete with water cement ratio of 0.45 and 28 day's compressive, split tensile and flexural strength of 20Mpa (2900 psi) and workability (slump and compacting factor) were studied. The effect of percentage replacement of manufactured sand on strength property and workability were evaluated and compared with reference mix of 0% replacement of natural sand by manufactured sand.

P.T.Santhosh Kumar1 and K.K.Sajeevan2 Even though concrete with CSFA has a reduced 28 day compressive strength than river sand (Table 1), it can be adopted for construction, as the strength obtained from CSFA is considerably more than that predicted by Fig. 47 of SP: 23- 1982. Also, IS: 383- 1970 permits the use of CSFA as fine aggregate if it confirms to the requirements in Table 4 of this code.

P.Aggarwal investigated that the bottom ash which falls into the furnace bottom can act as an alternative to natural sand as the Compressive strength of bottom ash concrete containing 50% bottom ash is acceptable for most structural applications since the observed compressive strength is more than 20 MPa at 28 days.

Mark James Krinke concludes that with the addition of a superplasticiser a concrete mix containing manufactured sand is capable of not only achieving a workability similar to that of natural sand, however to achieve this workability, dosages as high as 2.36 percent were required. The additional cost of these large amounts of superplasticiser in the concrete mix makes the manufactured sand concrete mix less economical to produce then a natural sand control mix. However with the declining availability of natural sands suitable for use in concrete, the use of concrete mixes containing 100 percent manufactured sand or high percentages of manufactured sands in the aggregate blend may become a lot more common.

Khadra Bendjillalia, , Mohamed. S. Gouala, ,Mohamed Chemroukb, ,Zineb Damenea The results of this investigation put in evidence the efficiency of the reinforcement of limestone mortars by polypropylene fibers waste in the improvement of their flexural tensile and compression strength.

Samir Shihada and Mohammed Arafa A severe strength loss was observed for all reinforced concrete beam samples having no polypropylene fibers. The loss is more than 60 % for a heating duration of 4.5 hours. Polypropylene fibers have a slight positive impact on ultimate strength of unheated tested beams. At 0.45 kg/m3 content, there is about 5 % gain in strength, while at 0.67 kg/m3 content the increase is more than 8 %.

Polypropylene fibers have a positive impact on ultimate strength of heated beams. For a heating duration of 4.5 hours, the residual ultimate strength is larger than the corresponding strength of beams without polypropylene fibers by more than 60 %.

The optimum percentage of polypropylene for use in improving fire resistance of reinforced concrete beams is about 0.67 kg/m3. For a temperature of 400 C° sustained for 4.5 hours, the loss in ultimate strength is less than half of that loss when no polypropylene fibers are used. As the content of PP increases, the slump of the mix decreases. Hence, for heavily reinforced concrete members, it is recommended to use superplasticizers to enhance the workability. The concrete cover to the reinforcement is insignificant in terms of promoting ultimate strength, especially at 4.5-hour duration. No sudden failures are observed in all beams containing polypropylene fibers.

G.Murali, C.M.Vivek Vardhan, R.Prabu, Z.Mohammed Sadaquath Ali Khan, T.Aarif Mohamed and T.Suresh 1. The specimen with steel powder as waste material was found to be good in compression which had the compressive strength of 41.25% more than the conventional concrete. 2. Better split tensile strength was achieved with the addition of the steel powder waste in concrete. The strength has increased upto 40.87% when compared to that of the conventional concrete specimen. 3. In flexure the specimen with soft drink bottle caps as waste material was found to be good. While adding the soft drink bottle caps the flexural strength increased by 25.88% that of the conventional concrete.

Vikrant S. Vairagade, Kavita S. Kene Compressive Strength We concludes that the compressive strength between S0.6P0.4 and S0.7P0.3 is increase high as compare to other interval. S0.8P0.2 Gives High Strength as Compare to other Combination Split Tensile Strength. S0.8P0.2 Gives High Strength as Compare to other Combination Slump Value Increasing the percentage of steel fiber in Hybrid Combination reduces the slump value, to maintain the constant slump we have to increase the superplasticizers dose in concrete.

O. Gencel, C. Ozel, W. Brostow and G. Martı´nez-Barrera Adding PP fibres to concrete has decreased the unit weight of concrete and increased the compressive strength of concrete. Monofilament PP fibres can be used at much lower content than steel fibres; the lowest steel fibre content used is 60 kg m3. Compressive strength, splitting tensile strength and especially flexural strength and elasticity modulus have been increased by PP fibre inclusion – while pulse velocity has decreased.

Rana A. Mtasher, Dr. Abdulnasser M. Abbas& Najaat H. Ne'ma Polypropylene fiber inclusions in amount of 0.4% and 1.5%increased the compressive strength up to 11% and 56% respectively. When polypropylene fibres was used in amount of 0.4% and 1.5% the increase of flexural strength 24.6% and 85% respectively. The average ratio of flexural strength to compressive strength is about 11.18%.Strength Prediction of Polypropylene Fibre Reinforced Concrete 309 4- Strength models established by regression analysis give predictions matching the measurement values.

Dr.P.Perumali, B.Thanukumari The results of reversed cyclic loading tests performed on one fourth scale exterior beam column joint models indicate that the fibre reinforced concrete is an appealing alternative to conventional confining reinforcement for providing adequate ductility. Steel fibre bridging across cracks in the concrete mix increase the joint shear strength. The synthetic fibres increase the ductility (large strain capacity) and energy dissipating capacity, the most important properties required for earth quake resistant structures. The specimen I F22 which is formed by using M20 with fibre reinforcement in the joint region, consisting of 1.5% of steel fibre and 0.2% of polypropylene fibre have best performance considering the energy dissipation capacity and ductility factor but the ultimate load carrying capacity is reduced by adding polypropylene fibre. The addition of fibre cocktail to concrete prevents the brittle failure of the joint. The addition of polypropylene fibre increases the energy dissipation capacity when the dosage of polypropylene fibre is 0.2%. Further increase in polypropylene fibre was found to reduce the strength of the joint and also energy dissipating capacity. The rate of degradation of stiffness decreases in the case of specimens additionally reinforced with fibres. Hence the cocktail combination of 1.5% of steel fibre and 0.2% of polypropylene fibre is highly recommended in beam-column joints subjected to reverse cyclic loading for M20.

III. CONCLUSIONS

The review of research work shows that the replacement of natural sand with artificial sand is fissile and behavior and strength of reinforced concrete will improved. Also the use of polypropylene fibre will enhance strength and behavior of reinforced concrete also improves resistance against impact loading and fire. Polypropylene fibers have a positive impact on ultimate strength of heated beams. For a heating duration of 4.5 hours, the residual ultimate strength is larger than the corresponding strength of beams without polypropylene fibers by more than 60 %. No sudden failures are observed in all beams containing polypropylene fibers.

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