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Article Title: **Experimental Investigation on Hempcrete**

Experimental Investigation on Hempcrete

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ABSTRACT

Concrete is an important construction material consisting of cement, sand and aggregate such as gravel or crushed rock, mixed with water. The most commonly used cement is Portland cement. The cement and water form a paste or gel which coast the sand and aggregate. When the cement has chemically reacted with the water, it hardens and binds the whole mix together; Fine and coarse aggregate make up the bulk of a concrete mixture. Manufactured sand is an alternative for river sand. Due to fast growing construction industry, the demand for sand has increased tremendously; causing deficiency of suitable river sand is most part of the word. Plain cement concrete is good at providing reasonable compressive strength but it tends to be brittle is nature and is weak in tensile strength and minimum resistance to cracking, poor toughness to overcome the concrete. In the present study of Hempfibre are used with conventional concrete. The combining of fibre s, often called hybridization. There is a growing awareness of the advantages of the advantages of fibre reinforcement techniques of construction all over the world. In the recent time there is a growing interest on the use of various type of fibre in structural applications. Experimental and analysis of results were conducted to study the compressive, tensile and flexural behavior of composite concrete with varying percentage of fibres added to it. The M20 grade of concrete is adopted with varying percentage of fibres ranging from 0.2%, 0.4%, 0.6%, and 0.8% on different characteristic of fibre are used in all construction.

Keywords: Hempcrete mixes, Slump cone test, Standard Consistency Test.

1 Introduction

Hempcrete is a type of concrete that includes fibrous substance that increases its structural strength and cohesion. Hempcrete has small distinct hemps that are homogeneously dispersed and oriented haphazardly. Hemps used are steel hemps, synthetic hemps, glass hemps, polypropylene and natural hemps. Some types of hemps produce greater impact, abrasion, and shatter–resistance in concrete. The characteristics of Hempcrete are changed by the alteration of quantities of concretes, hemp substances, geometric configuration, dispersal, direction and concentration. Hemps are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water.

2 Literature Review

The use of two or more types of hemps in a suitable combination may potentially improve

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the overall properties of concrete and also result in performance concrete. The combining of hemps, often called ization, is investigated in this paper for a M25 grade concrete. Control and two-hemp composites were cast using different hemp proportions of steel and polypropylene. Compressive test and split tensile strength were performed and results were extensively analyzed to associate with above hemp combinations. Based on experimental studies, the paper identifies hemp combinations that demonstrate maximum compressive and split tensile strength of concrete.

2.1 Collection of Materials

The materials that are usually used for preparing concrete mix are cement, fine aggregate, coarse aggregate and water. In this project hemp is added into the concrete mix as it imparts more strength to it.

- Fine aggregate: M sand
- Coarse aggregate
- Cement: Portland Pozzolona Cement (PPC)
- Hemp fibrous particle
- Water

2.2 Testing of materials

2.3.1 Specific Gravity of Cement

The specific gravity of cement is the ratio between the weight of a given volume of material and weight of an equal volume of water. Test is conducted to determine the specific gravity of cement according to IS 4031- 1988. The Le Chatelier flask is dried and filled with kerosene to a point on the stem between 0 and 1ml. the inside of the flask is dried above the level of liquid. The flask is immersed in a constant temperature water bath maintained at room temperature for sufficient time. The level of kerosene oil in the flask is recorded as the initial reading. 64g of cement is introduced into the flask so that the level of kerosene rose above the bulb portion. The cement should not be allowed to adhere to the sides of the flask above the liquid. The stopper is inserted in to the flask and rolled gently in an inclined position. The air is expelled from cement so that no air bubble rises to the surface of the liquid. The level of kerosene in the flask is noted. The specific gravity value of PPC should be near 2.9

2.3.2 Standard Consistency Test

The standard consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having 10 mm diameter and 50 mm length to penetrate to a depth of 33-35 mm from the top of the mould. The consistency test is conducted on cement to determine the quantity of water required to produce a cement paste of standard consistency and also to find out the initial and final setting time of cement according to IS 4031 (Part 4): 1988. 400g (W1)

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of cement is taken and is made into a paste with a weighed quantity of water (W2). The Vicat mould is filled with the cement paste (gauging time should be between 3-5mins) after keeping the mould over a non-porous glass plate. After the mould should be filled completely, the surface is smoothened and leveled by using a trowel. The mould is shaken slightly to expel the air. The mould is then placed under the Vicat plunger and the plunger is lowered gently to touch the surface of the paste. Then the plunger is released quickly and allowed to penetrate into the paste under its own weight. The penetration value of the plunger from the bottom is noted in the Vicat apparatus. The procedure is repeated until the penetration value obtained is in between 5-7mm from the bottom.

2.3.3 Setting Time Test

Initial Setting Time is regarded as the time elapsed between the times that the water is added to the cement to that the paste starts losing its plasticity. Final Setting Time is the time elapsed between the moment the water is added to the cement and the time when paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure. The setting time test is conducted to determine the initial and final setting times of the cement according to IS 4031(part 5): 1988. 400g of cement is mixed with 0.85 times water required to give a paste of standard consistency. The gauging time is kept between 3-5mins. The stop watch is started at the instant when the water is added to the cement. The Vicat mould is filled with the cement paste and the surface is smoothened and levelled using a trowel. The cement block in the mould is placed under the load bearing needle for finding its initial setting time. The needle is lowered gently to be in contact with the surface of the test block. Then the needle is released quickly. In the beginning the needle pierced the block completely. The procedure is repeated until the needle failed to pierce beyond 5+0.5mm measured from the bottom of the mould. The period elapsed between the time when the water is added to the cement and the time at which the needle failed to pierce the block to a point 5+ 0.5mm measured from the bottom of the mould is taken as the initial setting time. The period elapsed between the time when water is added to the cement and the time at which the needle made an impression on the surface of the test block while the attachment failed to do so is taken as the final setting time.

3 Mix Design

The ultimate aims of studying the various properties of the materials of the concrete, plastic concrete and hardened concrete is to enable a concrete a concrete technologist to design a mix for a particular strength and durability. Design of concrete mix requires the widely varying properties of the constituent materials, the conditions that prevail at the site work. Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The extend of quality control is

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often an economic compromise and depends on the size and types of job.

4 Mixing of Concrete

4.1 Hand Mixing

For hand mixing, the materials are stacked on a water-tight platform, which may be either of wood, brick or steel. The materials should be thoroughly mixed, at least three times, in dry condition before water is added. The prepared mix should be consumed in 30 minutes after adding water. The mixing by hand is allowed in case of small works of unimportant works where small quantity of concrete is required. For important works, if hand mixing is to be adopted, it is advisable to use 10 percent more cement than specified.

5 Casting of Specimen

The cubes and cylinders are casted for strength tests and durability tests. 15cm cubes are casted for compressive strength tests and water absorption test. 300 x150mm size cylinders and 50cm x 10 cm x10 cm size beam are casted to conduct split tensile strength tests.

6 Tests on Fresh Concrete

To determine the workability of concrete the various tests are to be conducted such as flow table test, compaction factor test etc.

6.1 Slump cone test

The slump test is used for the measurement of a property of fresh concrete. This is an empirical test that measures the workability of fresh concrete. The test is probably preferred due to simplicity of apparatus used and simple procedure. The slump test is used to ensure uniformity for different batches of similar concrete under field conditions. Mould for slump test, non-porous base plate, measuring scale, temping rod. The mould for the test is in the form of the frustum of a cone having height 30 cm, bottom diameter 20 cm and top diameter 10 cm. The tamping rod is of steel 16 mm diameter and 60cm long and rounded at one end. Clean the internal surface of the mould and apply oil. Place the mould on a smooth horizontal non- porous base plate. Fill the mould with the prepared concrete mix in 4 approximately equal layers. Tamp each layer with 25 strokes of the rounded end of the tamping rod in a uniform manner over the cross section of the mould. For the subsequent layers, the tamping should penetrate into the underlying layer. Remove the excess concrete and level the surface with a trowel. Clean away the mortar or water leaked out between the mould and the base plate. Raise the mould from the concrete immediately and slowly in vertical direction. Measure the slump as the difference between the height of the mould and that of height point of the specimen being tested. The slump having 0-25 mm are specified as low workability , having slump 25-50 mm are specified as medium workability , 50-90 mm for normal reinforcement concrete placed with vibration, and high workability concrete have 100 mm.

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7 Tests on harden concrete

7.1 Compression test

Compression testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time. Compression tests are used to determine the material behaviour under a load. The maximum stress a material can sustain over a period under a load is determined. Compression testing is often done to a break (rupture) or to a limit. When the test is performed to a break, break detection can be defined depending on the type of material being tested. When the test is performed to a limit, either a load limit or deflection limit.

8 Conclusion

Hempcrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinues discrete, uniformly dispersed suitable hemps. Hemp is a small piece of reinforcing material possessing certain characteristics properties. They can be thin or flat the hemp is often described by the parameter aspect ratio which is ratio of hemp length to its diameter. Steel hemps will not float on the surface of a properly finished slab, however, rain damaged slabs allow both aggregate and hemps to be exposed and will present as aesthetically poor whilst maintaining structural soundness. Hemps are capable of substituting reinforcement in all structural elements (including primary reinforcement), however, within each element there will be a point where the hemp alternative's cost saving and design economies are diminished. Strict control of concrete wastage must be monitored in order to keep it at a minimum. Hemps have good rigidity, corrosion resistant, high strength to weight ratio, electrically conductive, fatigue resistant and good tensile strength. The hemps provides three-dimensional reinforcement of the concrete. By this way, concrete becomes more tough and durable.

This study aims to study the mechanical properties of Hempcrete where the hemps used were consists of steel hemp and coconut (coir) hemp. For this purpose five mixes, one normal control mix and four Hempcrete mixes were prepared. The volume of steel hemp is kept content as 1% and the volume of coconut hemp varied as1%, 3%, 5% and 7% Slump Test was carried out for each mix in the fresh state in order to determine the workability of the Hempcrete. Meanwhile, compressive test, flexural test and split tensile test were carried out to study the mechanical properties of the Hempcrete. From the slump test all specimens show low workabilityy. For the result of Compressive split tensile and Flexural Test, the normal control mix shows normal strength development but all the Hempcrete mixes gain their strength higher the normal control mix. The expected outcome which is the strength of Hempcrete is higher than the strength of normal concrete did achieved.

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