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Experimental Study on Fiber Reinforced Concrete using Stem of Pearl Millet

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***Abstract*— As per the present study, so many Natural fibers are used in concrete as fibers to increase tensile strength of the concrete like leaf fibers, seeds and fruit hairs, grass and reeds, wood fibers, bast fibers, etc. In that category, stem of pearl millet is the one of the wood fiber and an effective fiber can be used in the concrete to increase the tensile strength of concrete. Usage of stem of pearl millet in concrete is economical, remarkable impact in compressive strength, tensile strength, flexural strength, creep and durability.**

Index Terms— Aggregates, Aspect Ratio, Cement, Concrete, Stem of Pearl Millet, Strength, Volume fraction.

I. INTRODUCTION

The biggest disadvantages of concrete are its low tensile strength and brittleness. The low tensile strength of the concrete is remedied by the high tensile strength of reinforcing steel bars cast into the concrete. Fiber reinforced concrete is a composite material that contains cement, sand, coarse aggregate, water and fibers. In this composite material, short discrete fibers are non-uniformly distributed over the concrete mass. Incorporation of fiber in concrete improves several properties like tensile strength, cracking resistance, impact and wear resistance, ductility and fatigue resistance. The stem of pearl millet improves ductility and flexural strength.

The amount of fibers mixed in concrete is a percentage of the total volume of the composite (concrete and fibers) known as "volume fraction" (Vf). The typical range of Vf is from 0.1 to 3%. The ratio of fiber length (l) to its diameter (d) is called the aspect ratio (l/d). Fibers with a non-circular cross section use an equivalent diameter for the aspect ratio determination. If the modulus of elasticity for fiber is higher than concrete, they help to carry the load by increasing the material's tensile strength. Incrementing the aspect ratio of the fiber usually segments the flexural strength and toughness of the matrix. One advantage of incorporating fibers in reinforced concrete is that it is possible to mix the fibers with the concrete and casting it in situ. There are several different types of fibers that are available for commercial and experimental use. The basic categories are steel, glass, synthetic and natural fiber materials (ACI Committee 544, 2001). The main areas of concern of using fibers are fiber pull-outand fiber breakage. Fiber pull-out occurs after the composite has cracked with the load still applied, which will cause the fibers to debond from the concrete and pull out of the composite if the stress is high enough. The fiber pull-out is mainly influenced by the interfacial bond strength between the concrete and the fibers. However, with stem of pearl millet is having very rough surface such a manner as to aid in the resistance of fiber pull-out.

II. PEARL MILLET

Pearl millet is the most enormously grown up millet. Because of its high tolerance capability in growing conditions such as drought, low soil fertility and high temperature, it is able be to grown in areas where other cereal crops like maize or wheat, would not survive. The concentration of Pearl millet production in the developing countries accounts for over 95% of the production and acreage. India continues to be the single highest in the production of pearl millet in the world, even though the area has been declining in the traditional growing states of Rajasthan , Gujarat and Haryana. Usually pearl millet is grown as a dry land dual-purpose grain and fodder crop although it is rarely irrigated in India, certainly the summer crop grown mainly as a forage crop.

Pearl millet grain is an essential diet for farm households in the world's poorest countries and among the poorest people. In Africa, the Sahelian region and the northwestern India, rural regions, pearl millet is an important cereal for consumption. Pearl millet fodder is an important livestock feed in the growing regions in India and Africa.

Pearl millet production in India was characterized as minimal resource in cultivation during 1970s with a small marketable surplus. But in recent years, it is being engaged more as market oriented crop that owes to the changes in utilization from mainly food use to many other additional uses in animal feed, potable alcohol, processed food, etc. So the availability of stem of pearl millet is more to use as fibers in concrete as an alternative than other fibers. Interest of using stem of pearl millet for construction is not new method in India. It is used in palace construction also in olden days in tamilnadu mixed with sap and clay. The best example for this type of construction is panchalam kuruchi palace which is built at the period of Umaithurai, brother of Veera Pandiya Kattapomman. The palace was built within 6 days which was stand against British Artillery Force. It is a great example for our pioneers engineering knowledge and understandings.

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Figure 1.Pearl Millet

In the following, there are presented some of the aspects resulted from the research made by students from Master of Engineering in structure discipline at the Gnanamani College of Engineering, Anna University.

It can also be mentioned that the first research sighted using stem of pearl millet in concrete took place and administrated by Mr. Soundhirarajan.

III. IMPLEMENTATION

Usage of Stem of pearl millet in concrete was varied by volume fraction and experimented. The experiments were conducted on compressive strength, tensile strength, split tensile strength, durability.

The design of concrete mix has been done as per IS10262:2009 and arrived quantities are,

Cement	=300 kg/m^3
Fine aggregate	=805kg/m^3
Coarse aggregate (20 mm)	=797 kg/m^3
Coarse aggregate (12.5 mm)	=425kg/m^3
Water	=165kg/m^3
Volume Fraction of stem of pearl millet	= 0.1% - 3%

Size of specimen used in compressive strength test was 150mm X 150mm X 150mm. Size of specimen used in split tensile strength test was 150mm diameter and 300mm height. Size of specimen used in flexural strength test was 500mm X 100mm X 100mm. The test specimens were cast in cast iron steel moulds. The mould specimens were applied with oil in all inner surfaces for easy removal of specimens after demoulding. The raw materials used for making concrete are weighed with correct proportions. Mixing was done up to the level a uniform workable concrete was achieved. The mixed concrete was placed in the moulds in three layers of equal heights which were then vibrated at each filling to get a uniform concrete without any segregation. After 24 hours the specimens were demoulded and placed in the normal atmospheric condition.

Workability of concrete was tested using slump test which is physical property of concrete.

Figure 2. Slump test

Mechanical properties of concrete were tested using following formulas.

Split tensile strength (f_t) = 2P / (3.14DL)

Where,

f_t = split tensile strength of the specimen in MPa
P = the specimen applied with maximum load in N ,
D = measured specimen diameter in mm, and
L = measured length of the specimen in mm.

Figure 3. Testing of Cylinder

Flexural strength (f_t) = PL / (BD^2)

Where,

f_t = Flexural strength of the specimen in MPa
P = Maximum load applied to the specimen in N
L = Span in mm
B = Measured width of the specimen in mm
D = Measured depth of the specimen in mm

Figure 4. Flexural test on prism

Durability of concrete was tested using pH test and water absorption test as per IS 1237:1959 on 150mm cube.

Percentage of water absorption = (W_s–W_d) / W_d

Where,

W_s –Weight of the specimen at condition of saturation.
W_d- Oven dried specimen Weight.

The cube compressive strength results at the various ages such as 7, 28 days for different replacement levels. Totally five mixes were used, for each mix three no's of cube specimen were cast. After casting, the specimens were immersed in water after 28 days the specimens were tested. In the volume fraction of 0.5%. 1.0%, 1.5%, 2.0% and 2.5%

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stem of pearl millet in concrete, the maximum compressive strength was obtained at 1.0%.

The Cylinder split tensile strength results at the various ages such as 7, 28 days for different replacement. Totally five mixes were used, for each mix three no's of cylinder specimens were cast. After casting, the specimen was immersed in water for curing purpose for 28 days. From the test results it was observed that the maximum Split tensile strength is obtained for mix 1.0% volume fraction of stem of pearl millet at the water-cement ratio of 0.55.

From the test results it was observed that the maximum flexural strength is obtained for mix 1.0% volume fraction of stem of pearl millet at the water-cement ratio of 0.55. And also modulus of elasticity is very low for stem of pearl millet. Comparatively it is lower than other fiber like steel and glass.

As per that the pH value, when we are adding natural cellulose, it may increase the base nature. Water absorption is very low compared with ordinary concrete.

IV. CONCLUSION

From the experimental investigations carried out on the strength characteristics concrete mixes the following conclusions are arrived at:

- Workability of concrete decreases when addition of stem of pearl millet in the concrete.
- Compressive strength increases with the increase in volume fraction % of stem of pearl millet @ 1.0%.
- At the age of 28 days the Compressive strength of 1.0% stem of pearl millet shows the highest strength when compared to other volume fraction of stem of pearl millet and this indicates that the optimized volume fraction of stem of pearl millet which is 1%.
- At the age of 28 days the split tensile strength of specimen having 1.0 stem of pearl millet shows the highest strength.
- The concrete made of stem of pearl millet is having more strength and durability compared to the normal concrete. From this study it is concluded the optimum % of stem of pearl millet is 1.0%.

REFERENCES

[1] Anuradha. R, Sreevidya. V, Venkatasubramani. R and Rangan. B.V, "Modified guidelines for geopolymer concrete mix design using Indian Standard", Asian Journal of Civil Engineering (Building and Housing) Vol.13 No.3, 2012.

[2] Rajini. B and Narasimha Rao. A.V, "Mechanical Properties of Geopolymer Concrete with Fly Ash and GGBS as Source Materials", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, Vol. 3, Issue 9, pp. 1107-1112, 2014.

[3] Bakharev. T, Sanjayan. J.G. and Chen. Y.B, "Resistance of alkali-activated slag concrete to acid attack" Cem.Concr.Res. 33, pp. 1607–1611, 2003.

[4] Cheng. T.W and Chiu. J. P, "Fire-resistant geopolymer produced by granulated blast furnace slag". Minerals Engineering, 16(3), pp.205-210,2003.

[5] Davidovits, "Soft Mineralogy and Geopolymers" Proceedings of the Geopolymer 88 International Conference, the Université de Technologie, Compiègne, France,2003.

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