A Review on Basic Study of Bendable Concrete

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Abstract- *Concrete is the most extensively used construction material which has high compressive strength. But one major weakness of concrete is the brittle facture behavior in tension, with low tensile strength and ductility due to this many deterioration problem occurred in the structures. Bendable concrete is also known as Engineered Cementitious Composite without coarse aggregate. Therefore on the basis of study of literature review and their studies ECC is class of ultra-ductile fiber reinforced cementitious composites characterized by high ductility and tight crack width control. A bendable concrete is reinforced with micromechanically designed polymer fibers. Engineered Cementitious Composite made with the combination of PVA fiber and Fly Ash as admixtures. The result of Flexural strength of various ECC mix with different percentage of fibers are compare with Conventional Concrete design according to Indian Standard.*

I. INTRODUCTION

Bendable concrete or Engineered Cementitious Composites (ECC) were originally developed in the 1990s by Victor C. Li at the University of Michigan, whose research was in part inspired by how animals like abalone produce the inner nacre of their shells. However, cost, supply chain concerns, and technical factors have prevented its widespread adaptation in the construction industry and its use has been limited to just parts of a handful of projects in Japan and the United States. However, a new development by Gabriel Arce, a construction management research associate at Louisiana State University is hoping to change that.

Arce led a multi-year project titled "Evaluation of the Performance and Cost-Effectiveness of Engineered Cementitious Composites Produced from Region 6 Local Materials," which experimented with an array of locally source able materials to develop a more cost-effective, scalable bendable concrete. The material, which comprises a cement, sand (fine aggregate), super plasticizer, fly ash, PVA Fibers, water. "The cost of our material is approximately 2.5 times that of regular concrete; typical ECC cost can be more than four times that of regular concrete," said Arce in a university publication. Considering the fact that structures using ECC can be built with less material and require less upkeep and repair, the gap in cost may actually be negligible.

Bendable concrete is filled with small fibers, generally polymer-derived, organized into a microstructure that helps give the material increased ductility in comparison to traditional concrete, which is prone to cracking and failure under strain and long-term use. Where standard cement only has a strain capacity of around .01 percent, bendable concrete's can be as much as 7 percent, meaning it is hundreds of times more flexible. Its fibrous structure also means it breaks in a safer, slower way—generating many "micro cracks" instead of the large cracks seen in traditional concrete. This means wear leads to smaller deformations, rather than full-on shattering or structural failure. Traditional concrete simply can't bend or give without breaking. Besides making infrastructure and buildings unsafe, these cracks, which can occur after a few years of use, require substantial amounts of time, material, and carbon output to repair. Over time this adds substantially to the financial and environmental cost of the building.

II. PURPOSE OF BENDABLE CONCRETEARE

- To solve some of the deck durability issues such as premature cracking.
- For long-term performance.
- To reduce environmental impacts
- Minimizes maintenances cost.
- For stronger, more durable and last longer

III. LITERATURE REVIEW

Title: Engineered Cementious Composites for Structural Applications

Conclusion: This study was conducted to compare with the standard mixing sequence, by mixing sequences increase the tensile strain capacity and ultimate tensile strength of ECC. The water to cementitious material (m/c) ratio 0.22-0.27 gives the best result High volume fly- ash ECC maintained its characteristics of multiple-cracking, strain hardening and tight cracks width control in extreme temperature condition. Compressive strength is directly related to the Flexural strength and inversely related to deflection but if the compressive strength is kept in limited ranges, the desirable

value of related parameters can be obtained. Compressive strength decreases with the increase in the cementitious material i.e. fly ash, silica fume etc.

Title: Parametric Study On Bendable Concrete

Author: Sagar Gadhiya M., SVIT; Prof T. N. Patel, SVIT; Dr.Dinesh Shah, SVIT

Conclusion: Bendable Concrete also known as Engineered Cementitious Composites abbreviated as ECC is class of ultra-ductile fiber reinforced cementitious composites, Characterized by high ductility and tight crack width control. This material is capable to exhibit considerable enhanced flexibility. An ECC has a strain capacity of more 3 percent and thus acts more like a ductile metal rather than like brittle glass. A bendable concrete is reinforced with micromechanically designed polymer fibers. The aim of this study is to investigate the hardened property (i.e. Flexural Test) of ECC by addition of steel, PVA & Hybrid fibers in different proportion. The result of Flexural strength of various ECC mix with different percentage of fibers are compare with Conventional Concrete design according to Indian Standard. All beams were tested under four-point loading test at different age in UTM, followed by different cross-section of specimen verifying from 50-125 having 700mm total length.

Title: Experimental Study on Bendable Concrete

Author: K.Selvakumar, R.Kishorekumar, A.Deivasigamani , Ms. S. Amutha

Conclusion: The compression and flexural strength of bendable concrete is done the values are compared with conventional cubes and slabs. Therefore it is proved that the bendable concrete is more strength than the conventional concrete and it is more flexible so that it resists cracks and acts as more efficiency in seismic regions.

Title: Bendable Concrete

Author: Chitari Nagesh Babasahebi

Conclusion: The Bendable Concrete is done the values are compares with conventional cubes and slabs. Therefore it is proved that the bendable concrete is more strength than the conventional concrete and it is more flexible so that it resists cracks and acts as more efficiency in seismic regions.

Title: The Self-Healing Behavior of Engineered Cementitious Composites

Author: S.Z. Qian, J. Zhou

Conclusion: The Self- healing behavior of Engineered Cementitious Composites is done the values are compared with conventional cubes and slabs. Therefore it is proved that the bendable concrete is more strength than the conventional concrete and it is more flexible so that it resists cracks and acts as more efficiency in seismic regions.

IV. APPLICATION OF BENDABLE CONCRETE

The main applications of flexible concrete are:

1. Construction of Roads and Bridges

Construction of roads and bridges using flexible concrete eliminates the use of expansion and contraction joints. This is because the flexible concrete has the ability to change its shape within it.

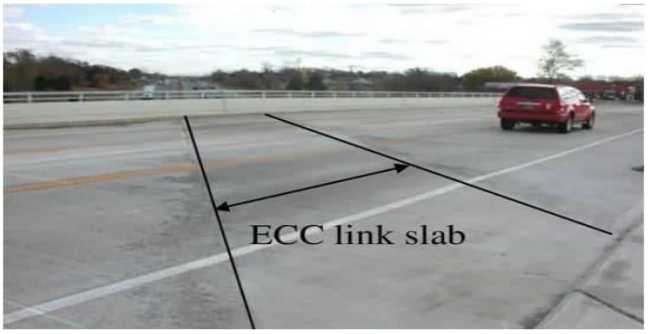

Fig. ECC link slab, which replaced a conventional expansion joint on a Michigan bridge deck, has lasted over a decade without repair or maintenance

2. Construction of Earthquake Resistant Buildings

Buildings made out of flexible concrete have the ability to take more tensile stresses. Hence, these can resist high vibration caused due to dynamic forces like an earthquake.

3. Construction of Concrete Canvas

The concrete canvas mostly constructed for military purposes is supposed to be highly strong and durable. This can be achieved efficiently by the use of flexible concrete.

4. In addition during 2003, an earth retaining wall in Gifu, Japan, was repaired using ECC. Ordinary Portland cement could not be used due to the severity of the cracking in the original structure, which would have caused reflective cracking. ECC was intended to minimize this danger; after one year only micro cracks of tolerable width were observed.

V. ADVANTAGES OF BENDABLE CONCRETE

- The flexible concrete has the ability to bend like a metal.
- It is more Stronger, more durable, and lasts longer than conventional concrete
- It has a self-healing property that is it can heal itself by using carbon dioxide and rainwater
- It is not brittle like a glass
- It is more resistant to cracking
- It does not emit that amount of harmful gases as compared to conventional concrete.
- The flexible concrete is approx. 20-40 percent lighter
- The use of steel reinforcement is reduces and can be eliminated
- It reduces the cost of the project
- It can be used as precast concrete.

VI. DISADVANTAGES

- It has high initial cost as compared to conventional concrete.
- It needs some special type of materials which can be difficult to find in some areas.

VII. CONCLUSION

On the basis of literature review following conclusions are arrived at:

- Bendable concrete plays an important role in the construction of building.
- The use of bendable concrete goal is to adapt the design of the building so that it can control the strength of the building.
- Bendable concrete is multi-functional in building construction.
- Bendable concrete can reduce the environmental impact, especially to humans and flora.

VIII. ACKNOWLEDGEMENT

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