Applications of Engineered Cementitious Composites (ECC)

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Abstract – Engineered Cementitious Composites (ECC) is a ductile composite which finds its large range of application. This paper is indented to explore the application of ECC and the new possibilities. ECC is an engineered mix and designed according to the property it has to exhibit. The ingredients and mix proportions varies according to the use, sometimes it is incorporated with other materials to produce improved version.

Key Words: ductile, deformability, high energy absorption, shear resistance, damage tolerance, crack-width control, bonding.

1.INTRODUCTION

Engineered Cementitious Composites (ECC) contains water, cement, sand, microfiber and chemical additives. It does not contain coarse aggregate as it affects the ductile behavior of the composites. Mixing, placing and compaction of ECC are same as that of normal concrete.ECC has high scope in civil engineering application due to its ductile nature. Presently more works are carried out to find its mechanical performance, physical properties, shrinkage and durability. Due to its ductile nature, ECC structural failure is less likely to happen. In most of the concrete structures, repair and maintenance is a better option than replacing them and ECC is currently used for such purpose.

2. APPLICATIONS OF ECC

Due to numerous researches that are taking place in the field of ECC, its application is also expanding. Some of the important applications are explored through this paper.

2.1 Strengthening of Masonry Beams

Many of the structures throughout the world are constructed using masonry. The strength and ductility of these brittle brick masonry structures are limited. ECC can be used to strengthen them. Precast ECC sheets are bonded to tension face or to both tension and compression face of masonry beams.

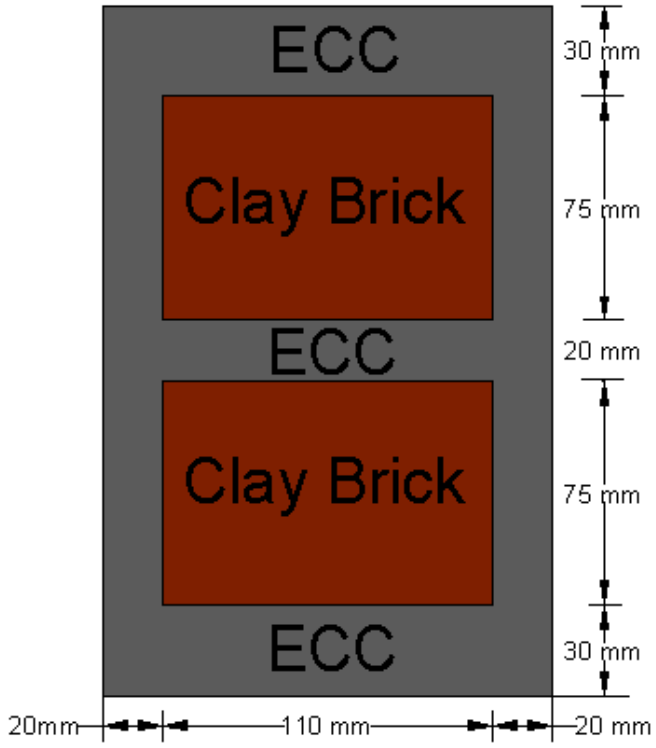

Fig.1. Cross-section of Masonry Beam with ECC as Bed Joint (S. B. Singh et.al)

2.2 Repair and Retrofit of structures

ECC is used for repair and retrofit of existing structures to prolong the life span of structures. The unique ductile property of ECC is suitable for applications in repair and retrofit of existing structures as well as for new structural applications. In some cases the base material is made of ECC or lined by it. In some structures in seismic regions, the shear structural wall is made of ECC. Behavior of ECC is similar to steel due to its ductility. This property of ECC is taken into account for using in structural elements. ECC is also combined with other materials like FRP for high performance.

2.3 ECC Lining

Normal concrete linings crack under external loads and result in structural failure. Replacing ECC lining can increase toughness and reduce cracks. Improving the tensile properties of ECC materials can help improve the mechanical performances of tunnel linings, especially their ductility.

2.4 Hinging Zone

The use of ECC for hinging zone of beam is highly researched. ECC shows ability to redistribute the damage at joints and results in increase life span of structures.

2.5 RC Beams Strengthened with ECC

RC beams are bonded to ECC layer to increase its flexural strength. It is normally bonded to the bottom of beam. In some cases sides of the beam is also bonded to ECC.

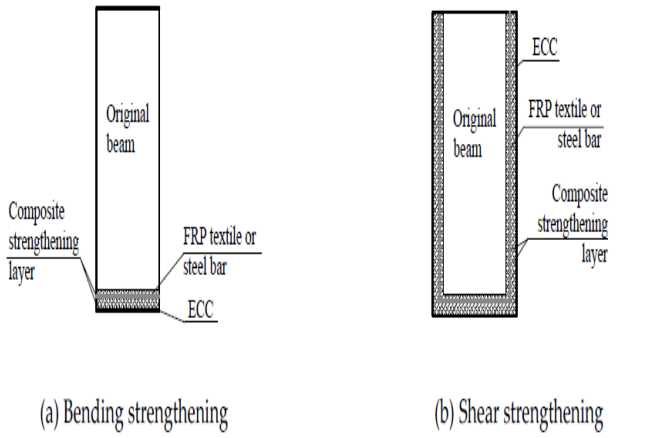

Fig.2 Two strengthening schemes for beam (Xing-yan Shang et.al)

2.6 Construction of Bridges

In developed nations, ECC is employed in construction of bridges. ECC can be used for those structures which are affected by harsh environmental condition especially bridges. Structural failure of bridges is mainly due to the corrosion of rebars and providing ECC cover to them can reduce the penetration of corrosive agents to reinforcements.

2.7 Beam-Column Connections

ECC layer is also provided in the beam column connections to improve the structural safety.

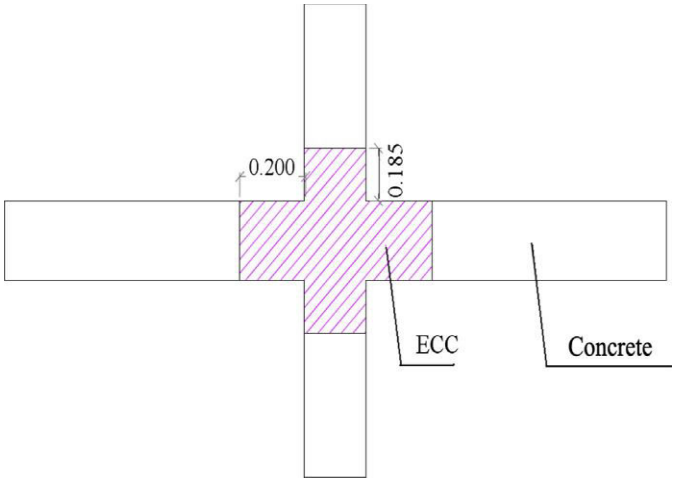

Fig.3 ECC in Beam-Column Connection (Salahuddin Qudah et.al)

3. CONCLUSION

Concrete structures cannot be replaced frequently. Instead, they should be repaired and maintained with materials like ECC. Materials like ECC should produce a long lasting effect and produce a durable infrastructure system. ECC is found to have the ability to bridge the internal forces between the crack sides due to its high ductility and perfect contact with the substrate concrete without any use of adhesives. It is found that, as the thickness of ECC increased, the ductility of structure is also increased. Many of the properties of ECC, including satisfactory deformability, high energy absorption, shear resistance, damage tolerance, and crack-width control, makes it a better choice for repair and retrofitting works.

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