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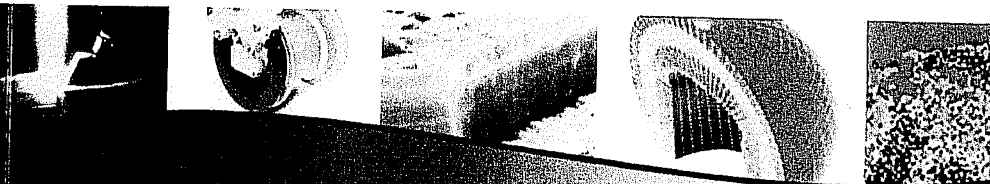
Multiscale, Multifunctional and Functionally Graded Materials



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SELF-MONITORING COMPOSITE RODS: PROPERTIES ASSESSMENT

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External dynamic loading and severe environmental conditions are the major cause of deterioration in reinforced concrete structures. The corrosion of steel reinforcing rebar is the dominant cause of concrete structure degradation. The most effective way to prevent corrosion of steel rebar is the use of a corrosion resistant reinforcing material, such as fiber-reinforced-polymer (FRP) composites. The types of FRP composites best suited for the reinforcement of concrete are those providing high strength, high stiffness, and environmental compatibility with concrete. Most commercial FRPs are rod-like elements that are pultruded, shaped, and treated so that surface texture provide mechanical adherence with concrete. Nevertheless, the interest in the safety of concrete structures has increased and monitoring and maintaining their safety has become a main goal. To achieve this main goal monitoring systems that can be applied to the reinforced concrete elements are required. The damage sensing is conventionally performed by attached or embedded damage sensors, such as optical fibers, acoustic sensors, etc. however these sensors have limited application because of high cost, low durability, and limited sensing volume and spatial resolution. One solution is that the materials themselves can possess a self-diagnosing function for fracture; thus, strong and heavy design, complex and expensive equipment and numerous sensors becomes unnecessary. Structural materials have evolved from materials that are mechanically strong (such as steel) to materials that are both strong and lightweight (such as composite materials) and most recently to materials that are both strong and self-monitoring. By definition, a self-monitoring material is one which can sense its own strain and damage. For example, the basic principle of the carbonaceous smart structural material to detect strain or damage lies in the electrical conductivity of the carbon fibers, as already known from the literature. As the carbon fibres are electrically conductive, the composite itself can exhibit electrical properties, which will depend upon strain, damage and temperature. The self-diagnosing structural material may, in this way, provide determination of the strain or damage by measuring the change in the electrical resistance during real time loading.

In this work the monitoring capabilities of composite rods and the differences in the sensing behavior related to the different carbon fiber content are investigated. In current research work, hybrid, carbon fibre and glass fibre reinforced composite rods were tested for sensing performance.

Keywords: Fibres; Fibrous structures; Self-compacting concrete; Textile reinforced concrete.

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