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Characteristics of concrete with graphene and carbon fibers for marine environment

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Addition of small discrete micro and macro fibers in controlling the growth of cracks in concrete is a wide practice in recent decades. Use of discrete fibers result in more uniform stress distribution in concrete and this delay the nucleation and the growth of micro/nano crack. Steel fibers, carbon fibers, glass and polymeric fibers are used to control the cracks at microscopic level, whereas nanofibers/particles such as nanosilica, nanoalumina, nanoiron oxide, nanotitanium oxide, nanoclay and grapheme oxide are used to control the cracks at nanoscopic level. Chopped carbon fibers are added in concrete to increase the flexural toughness of concrete. As marine concrete is prone to severe durability issues, this paper aims at characterizing high performance concrete with graphene and chopped carbon fibers which can be used for the construction of coastal structures. Design of experiments with central composite design has been adopted to design the trial mixes for this work. The experiments were carried with the designed values. The strength properties like compressive strength, flexural strength and tensile strength were studied. Apart from this, durability characteristics like concrete impermeability and rapid chloride penetration was also carried out. It was observed that the strength properties increased by 22% for 0.05% of graphene oxide and incorporation of chopped carbon fibers up to 0.05% improved the flexural toughness by 28%. The concrete was found to be resistant to chloride penetration and it was impermeable to water. Results show that this material can be potentially used as construction material for structures that are exposed to severe marine environment.

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