Synopsis

Thesis Title : Engineering of Carbon Nanotube Reinforced Cement

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Cement, the most extensively used construction material, has very less tensile strength and ultimate strain capacity. It is a great challenge to improve the properties of the cement and to impart novel properties to it. Macro to micro fiber is being added to cement which prevents crack growth and improves the tensile strength of the cement. Nanomodification of cement is an emerging field. The extraordinary mechanical properties of nanomaterials and its capability to enhance the engineering properties of the materials such as polymers have encouraged the civil engineers to evolve a new construction material by exploiting the advantages of nanomaterials. Among the available nanomaterials, Carbon Nanotubes (CNTs) is found to have extraordinary mechanical, electronic and thermal properties. Owing to the superior mechanical properties of CNTs, research has been initiated to use this nanomaterial in cementitious materials. Hence, it is utmost important to know the mechanical properties of CNT for its usage in cementitious material. There is very few attempts have been made to evolve a procedure to calculate the Young's modulus of CNT. Nevertheless, the methodologies and the findings are widely scattered. Nanoscale continuum theory uses a representative volume to determine the Young's modulus which does not consider the geometrical parameters. A validated numerical model is used to include these effects and finally a unified approach combining the interatomic potential and numerical simulation has been proposed to determine the Young's modulus of the CNT for a given structural arrangement (chirality and radius). The Young's modulus of CNT, as observed from the study, is used to model the Representative Volume Element of CNT reinforced cement. Expressions derived from strength of materials approach are used to determine the mechanical properties of the RVE subjected to different types of loading and various structural parameters are studied. The effect of various parameters like percentage of CNT and arrangement of CNTs in cement matrix on the strength and stiffness of CNT reinforced cement is also investigated. With the evaluated properties of CNT reinforced cement, investigations have been carried out to estimate the extent of improvement in response of structural components by varying the proportion of improved material to the conventional one. The findings from the study carried out will be helpful for developing new/modified cementitious construction materials with enhanced engineering properties.