

Develop Material Systems for Next-Generation Infrastructure

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Abstract

The demand for construction materials continues to rise as the infrastructure development spreads. There is a looming crisis for raw materials used in construction running low due to this high demand, and the material-intensive nature of the current construction practices adds to this. The use of novel materials and their potential applications are no longer limited to highly technical areas. The computer power developing exponentially adds another dimension to material engineering which makes it possible to develop and characterize novel materials for the next generation infrastructure.

Novel materials can be in the form of novel fibers, memory materials, and bio-inspired materials. Research has been carried out to investigate the suitability of natural fibers, such as cotton, in composite construction, and how the strength properties of structural elements can be improved using carbon fibers. The potential and limitations of shape conscious materials (shape memory materials) have been studied recently. The application of such materials to enhance structural performance, and mitigate natural disasters is being investigated, and the construction industry will benefit significantly upon it being proved acceptable. Bio-inspired materials are synthetic materials whose structure, properties or function mimic those of natural systems. For example, physical properties of a material such as adhesion can embody attributes of a gecko, and self-cleaning surfaces may be inspired by the super-hydrophobic nature of a lotus leaf. They make use of the logical argument: if it works in nature, it could be scaled up to develop infrastructure.

These novel materials often have improved performance aspects, and they make sustainable structural concepts feasible. For example, a novel adhesive material could offer a possibility for instruments to be attached and detached easily and self-cleaning surfaces will reduce the maintenance cost of infrastructure and also the use of chemical cleaning materials. However, developing and characterizing a novel material is a time-consuming task which represents a large commitment of resources. The operational implications such as maintainability and resilience of infrastructure built with such novel materials are to be fully understood and accepted before their implementation.