Nanotechnology and Smart Structures in Civil Engineering

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ABSTRACT

Nanotechnology is that the area of technology where different materials are manipulated to some nanometer (10^{-9}m) scale either up by bottom up from single group of atoms to bulk matter or by top down which is reducing bulk materials to a bunch of atom. Nowadays, nanotechnology is being considered for the fabrication and manufacturing of the many electronic devices, in medical equipment's, medicines, cells and fabrics. a wise structure may be defined as a structure which behaves in systematic manner and environmental friendly.As compared to standard structures, smart structures are reliable,durable and have high resistance against heat and impact. Also strength and durability of individual components of structure enhance dsignificantly. the most purpose of building smart structures is to enhanced lifestyle/comfort of

human and provides them safety against any sort of impact like fire, earthquake, flood, tornado etc. It also reduces the price of maintenance and senses itself if there's any work of maintenance is required. the current paper describes the assorted advantages of nanotechnologyin the development of smart structures. Complex Structures made by Cement, Concrete and Steel may be made at nano-level to boost their performance. Using

nanomaterial's in construction will

give many benefits like behavior and mechanical properties like durability, skid resistance of pavement employed in highway work may be improved. Further more structures made by nanomaterial's give good aesthetics, glasses made by nanomaterial's are self-cleaning and improves more properties.
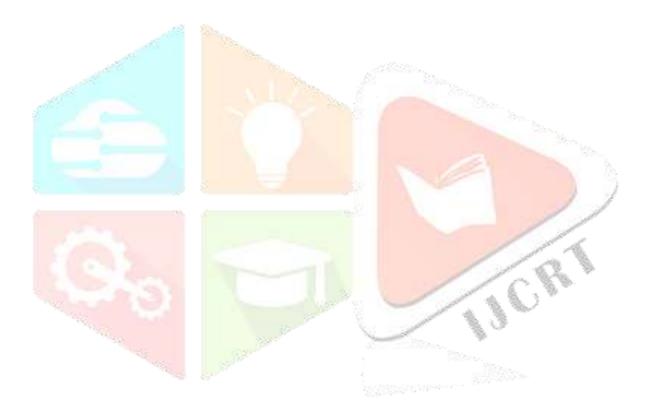
INTRODUCTION

Nanotechnology is that the technology or the study of extremely small structure having size of 0.1 to 100nm. it's used for better built, longer lasting, cleanser, safer and smarter products for home, communication, medicine, transportation, agriculture and plenty of other applications. Like other technologies, nanotechnology requires proper knowledge and skills from many alternative fields like physics,chemistry,biology, appl ied science, technology, technology, etc. [1] Nanotechnology introduced in 1959 and presently widely employed in different sectors. Nontechnology features a large potential to boost the standard construction and converts the structures to a wise structure. The precise properties of nanomaterial's are:-

a. Larger specific area
b. Higher chemical activity
c. Higher Adsorption capacity
d. Great sensitivity
e. Self-assembly nature
f. Long-term stability

Studies conducted within the past indicated that the indicated that the nanotechnology implemented in structures makes it more reliable, workable and sturdy [1-8]. Studies also suggested that with help of nanotechnology, self-sensible, self-cleaning and self-reparable properties within the material or composites cab be introduced. the current paper discusses the assorted aspect of nanotechnology in smart structures. The manipulation of matter on an atomic, molecular and super molecular scale is

termed as Nanotechnology. Description of nanotechnology was capable by National Nanotechnology Initiative. They define because the manipulation of matter with a minimum of one dimension sized from 1 to 100 nanometers. Functional systems of materials are engineered at molecular scale in nanotechnology. The projected ability to construct items is referred by

nanotechnology. The mentioned process is finished through various techniques and tools which make the resultant products as complete and high

performing. kinds of devices are made in nanotechnology to supply nanomaterial's the manipulation of matter on an atomic, molecular and super molecular scale is termed as Nanotechnology. Description of nanotechnology was capable by

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SMART STRUCTURES

A smart structure refers to structure which is smart and have self-supporting features. It senses stress, temperature, deformation etc. and up to certain levels it performs the 'self-treatment'. It behaves during a systematic manner and user friendly. Increase in research and technology makes it to serve for better lifestyle of mankind. As compared to traditional or conventional structures, smart structures are more durable, healthy and workable. It provides better service and lifestyle to people. Also it's higher heat and vibration resistance, better temperature control and ventilation and safety standard. Also smart structures are environmental

friendly, energy efficient and have self-cleaning properties. Smart structures

are manufactured from single or composites materials. By using the nanotechnology the fabric properties

have been enhanced. Uses of recent technology make it sensible. There are three main elements of a

wise structure

i. Structural elements
ii. Coating or protecting elements
iii. Monitoring elements

Structural elements: It consists of skeleton of the structure like beams, column, roof, outer wall etc. the look of those elements depends upon the structural load. Structural load could be a combination of burden, live load, wind load, earthquake load and lots of others. Before construction it should be assured that the all the structural load are fully examined. The structure should be safe against any style of failure. Using smart materials or nano-materials, the properties, resistance and stiffness of the structural elements is enhanced. However, it depends upon the sort of structural and its application. as an example to construct a building

there are some requirements like 'all elements are safe against wind or earthquake load' and for building a ship there are requirement like'the ship should be safe against sinking'. Nano-materials is easily fitted to any components of the structure and a desirable structure is made with enhanced properties.

Coating or protecting elements: These elements protect the complete structure from adverse weather, rust, erosion, vibration and lots of more. It consists of various components like vibration and shock absorbers, heat and thermal insulators, water proofing paints, self-cleaning glasses etc. they provides better lifestyle and luxury the people and appears attractive. By proper ventilation and warmth insulators the temperature of the structure is maintained and controlled at desired levels. Vibration and shock absorbers protect the structures for several unacceptable vibration and shocks thanks to earthquake and machines. Self-cleaning glass protect the within of the building from direct sunlight, dust and powerful wind. These elements create a user – friendly environment at inside the structure and make the people efficient for work. By using electronic devices the operation of a number of these elements is controlled.

Monitoring elements: to guage or monitor the performance of the smart structure monitoring systems are used. Generally it's termed as "structural health monitoring system". It includes, smartsensors, devices, monitoring equipment and controllers. the

most aim of this technique is to critically monitor the performance of every components of the structure and if they're not behaving as desired report back to concern authority immediately. Controllers attached thereto control the vibration, shocks, heat, ventilation etc. at certain levels. However its rely on the look of the structure and their maximum loading capacities. Structural health monitoring system, monitor the deformation, stress and temperature of the individual structural elements and if these value are exceed from their limiting values, it alarm matters. During emergency situations like fire, earthquake, tsunami etc. it maximizes it performance at the best. the most important advantage of this technique is to its alarming before any problematic situations. However still research goes on to optimize the performance of monitoring systems.

APPLICATIONS

As we've got discussed many nanoparticles, their properties and construction materials which may be modified by nanomaterial's to boost in construction methods. Now we are going to see how these materials is beneficial in various streams of applied science Public safety is preferred over any think about construction. to create safe structure, engineer must must follow some construction processes. Using nanotechnology within the process may aid to create better structures. In applied science many construction materials like concrete, steel, clay etc. have the property to soak up heat. They absorb sunlight and transfer heat to the room. This causes rise of temperature which isn't good for human health. With nanotechnology, thermal insulation is achieved by the assistance of some specially engineered nanomaterial's.

Better interaction or bonding of particles at nano or micro structural levels which enhanced the resistance, strength, thermal resistance, and shock absorbance.

Self-reparable, self-cleaning and self-alarming properties make the fabric or composite smart i.e. it senses the strain, temperature, deformation at early state. Continuous monitoring of it generates the utilization full data which may be used for further

improvement.

Reduction in maintenance cost thanks to sensible and intelligent properties.

Safety against natural calamities like earthquake and tsunami if energy absorbent techniques are combined with nanotechnology.

Re-habitation of old or conventional structures, with the assistance of nano- sensors, optical fibers and nano-scale solutions.

CONCLUSION

The nanotechnology provides energy efficient, durable, safe, comfortable and environmental friendly smart structures. Strength, stiffness, shock and vibration absorbent, thermal and warmth resistance and self-cleaning properties are enhanced thanks to use of nanomaterial's and its relative technology. Further structures smartly sense deformation, vibrations and warmth. However, the initial cost of construction is high but it'll be reduced as improvement in technology and research. From the introduction of nanotechnology, nanomaterials and nanoparticles, one can conclude its importance in era. Basic construction materials cement, concrete and steel will also benefit from nanotechnology. Addition of nanoparticles will lead to stronger, more durable, self-healing, air purifying, fire resistant, easy to clean and quick compacting concrete. Some of the nanoparticles that could be used for these features are nano silica (silica fume), nanostructured metals, carbon nanotubes (CNTs) and carbon nanofibers (CNFs). Nanotechnology, supported this review, is used as an addition to some construction materials to reinforce their basic properties. Briefly, it is understood that nanotechnology is extremely beneficial to several fields specially applied science. Vastamount of enhancement is applied to several construction materials to boost their quality and solve many issues associated with applied science. benefits are rapid hydration, increased degree of hydration, and self-cleaning (in concrete); superhydrophilicity, anti-fogging ,and fouling resistance.Nanotechnology is used not only in construction material but also in various equipment's

and construction techniques additionally as various fields of Civil Engineering. Nanotechnology is that the key to develop a wise and novel world. Nanotechnology is the key to develop a smart and brand new world.

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