

## Research Paper On Application of Nanotechnology in Smart Civil Structures

Ravi Prakash Verma

Rohit Kumar Gautam

Mohit Kumar

### Abstract

*Nanotechnology has the potential to make construction faster, safer, cheaper and more varied, resulting in smart construction. Automation of nanotechnology construction can allow for the creation of structures from advanced homes to gigantic skyscrapers much more quickly and at much lower cost and higher efficiency. In the near future, Nanotechnology can be used to sense cracks in foundations of structures and can send nanobots to repair them. It can also provide self powered failure prediction and prevising mechanisms for high capital structures.*

### INTRODUCTION

Civil engineering is always bounded within cement, sand, stone and aggregate, but it is way beyond that. It deals with innovation at each and every step of constructing a structure. After military engineering, the second oldest engineering discipline is none other than civil engineering. It is traditionally splintered into several sub-disciplines consisting of structural, architectural, geological, geotechnical, environmental, transportation, earthquake, water resources, quantity and construction surveying, municipal or urban and construction engineering.

### Nanotechnology

The American physicist, Richards P. Feynman raised and put forward nanotechnology in his famous lecture at the California Institute of Technology in 1959. The word “Nano”, which is evolved from the Greek word for dwarf, indicates a billionth. Nanotechnology is the use of minute particles of material either by themselves or by their manipulation to generate new large scale materials. The size of molecule, though, is very significant because at the length scale of the nanometer,  $10^{-9}$  m, the properties of material affects considerably. A

billionth of a meter corresponds to a single nanometer. It concerns with particles ranging between 1 to 100 nanometer in size.

Nanotechnology is not a new science or technology, it is rather an augmentation of the sciences and technologies which already exist from many years and it is logical progression of the work that has been done to analyze the nature of our world at an even smaller scale.

### **Need of Nanotechnology in construction**

Nanotechnology has changed and will pursue to change our perception, expectations and abilities to control the materials world. Several applications have been developed for this specific sector to improve the energy efficiency, durability of construction elements, and safety of the buildings, delivering the ease of maintenance and to provide increased living comfort. The role of nanotechnology in conceiving of innovative infrastructure systems has the potential to transform the civil engineering practice and dilate the vision of civil engineering. Many disciplines of civil engineering, in conjunction with design and construction processes can be benefited from this technology. For example, new structural materials with unique properties, stronger and lighter composites, sound absorber, fire insulator, low maintenance coating, nano-clay filled polymers, self-disinfecting surfaces, water repellents, air cleaners, nano sized sensors, solar cells, ultra thin-strong-conductive wafers etc.

### **CONCLUSION**

The idea of the presented review paper revolves around the implementation of nanotechnology in building a smart and efficient infrastructure. It reveals the utmost need of application of this technology in the field of construction for sustainable development. Various nanoparticles and their application areas in construction of smart structure for leading a smart city and setting a positive impact on environment have been discussed in this review paper. The article further emphasizes more on the futuristic implementation of nanotechnology and gives an idea on applying the concept of super hydrophobic coating and water absorbing concrete in construction industry for the development of smart city leading to smart nation. In short, this paper concludes with a strategic plan on how civil engineering can be benefited with the implementation of nanotechnology resulting in construction of smart structures.

## REFERENCES

- [1] Mann, S. (2006). "Nanotechnology and Construction," Nanoforum Report. www.nanoforum.org, May 30, 2008.
- [2] Beatty, C. (2006). "Nanomodification of asphalt to lower construction temperatures." NSF Workshop on Nanotechnology, Material Science and Engineering, National Science Foundation, Washington, DC.
- [3] ASCE. (2005). "Report card for America's infrastructure. American society of civil engineers" "http://www.asce.org"(Mar. 8, 2008).
- [4] Bartos, P. J. M. (2006). "NANOCONEX Roadmap-novel materials." Centre for Nanomaterials Applications in Construction, Bilbao, Spain "http://www.mmsconferencing.com/nanoc/" (Jan. 13, 2008).
- [5] Shah, S. P., and A. E. Naaman. "Mechanical Properties of Glass and Steel Fiber Reinforced Mortar." ACI Journal 73, no. 1 (Jan 1976): 50-53.
- [6] Saafi, M. and Romine, P. (2005). "Nano- and Microtechnology." Concrete International, Vol. 27 No. 12, p 28-34.
- [7] Sandvik Nanoflex Materials Technology. http://www.smt.sandvik.com/nanoflex, May 30, 2008.
- [8] Sobolev, K. and Gutierrez, M. F. (2005). "How Nanotechnology can Change the Concrete World," American Ceramic Society Bulletin, vol. 84, no. 10, p. 14-16.
- [9] Song, Gl, Gu, H. and Mo, Y. (2008). "Smart Aggregates: Multi-Functional Sensors for Concrete Structures—a Tutorial and a review." Smart Mater. Struct. vol.17.
- [10] Balaguru, P. N., "Nanotechnology and Concrete: Background, Opportunities and Challenges." *Proceedings of the International Conference – Application of Technology in Concrete Design*, Scotland, UK, p.113-122, 2005.
- [11] Z.D. Bolashikov and A.K. Melikov Methods for air cleaning and protection of building occupants from airborne pathogens, Building and Environment (2009); Vol.44, no.7, p.1378–85.
- [12] M. C. Roco, R. S. Williams, and P. Alivisatos, Nanotechnology Research Directions: IWGN Research Report, Committee on Technology, Interagency Working Group on Nanoscience, Engineering and Technology (IWGN), National Science and Technology Council, (1999).