

Nanomaterial for Smart Future Buildings

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Abstract. Due to increasing population and the upcoming problems in the world humans have discovered new technologies and new materials in order to program daily life. One of man's serious concerns has been how to build constructions and manage buildings since the beginning of the human history .Some of these problems are resource limitations , increasing pollution and economic challenges .Therefore , talking about smart building which are dynamic and capable of repairing themselves is one of the most important sessions between architects and energy experts. Architecture and building technology on the basis of nanobuilding structures and nanomaterials are going through some significant changes and developments . Nano technology is one of the most important outcomes of the twenty-first century key technologies while it's economic impacts are also recognized .New materials are being discovered and developed every day as a result of investigating ways to achieve molecular and atomic precision in engineering of material. These new materials present new opportunities to solve problems like heat absorbing windows , energy coating and etc.. [1] . Thus using nanotechnology could avoid wasting of energy and it could be seriously useful for saving resources. Then it could decrease pollution . Moreover , because of dynamic and smart nature of nanomaterials ,they are very good alternatives in order to save money . Therefore , studying how to use nanomaterials in construction styles is increasing by researchers all over the world day by day.

Keywords: nanomaterial , architecture , natural recourses , environment friendly

1. Introduction

Nano architecture will allow designs to interact better with the human senses .Experiencing this type of architecture is closer to nature and less forced than many of the designs we are experiencing today .In architecture and the construction industry nanotechnology has potentials that are already usable today , specially the coating of surfaces to lend them functional characteristics such as increased tensile strength , self cleaning capacity , fire resistance , and others . Additives based on nanomaterials make common materials lighter , more permeable , and more resistant to wear . Nanomaterials are not only extremely useful for roofs and facades ; but they also expand design possibilities for ecologically oriented architects. [3]. By merging both nanotechnology and architecture , the advent of nanotechnology will give architects renewed freedom that we don't experience today. It is interesting to think of architecture as a growing environment that evolves according to different respective codes. Nano architecture could treat such codes or rules as a way to optimize intended functions and aesthetics. Architecture would then be more of a dynamic entry, morphing to occupant needs.

2. Nanomaterials for Saving Energy in Architecture

Smart buildings concerning biodegradable features and nanobuilding facilities are current architectural aspects of space design .Designers should be capable of new architectural innovations as nanomaterials during design process .The nanohouse is a new type of ultra-energy efficient house exploiting the new materials being developed by nanotechnology .HydroHouse uses natural airflow and seawater to cool and make the greenhouse humid . Seawater is evaporated at the facades of the greenhouse; as air passes into the green house ,it increases the humidity. But the smart part is in the structural columns, which also serves as supports for the growing racks. When it rains , fresh rain water is allowed to trickle down from the roof , within the cylindrical columns.

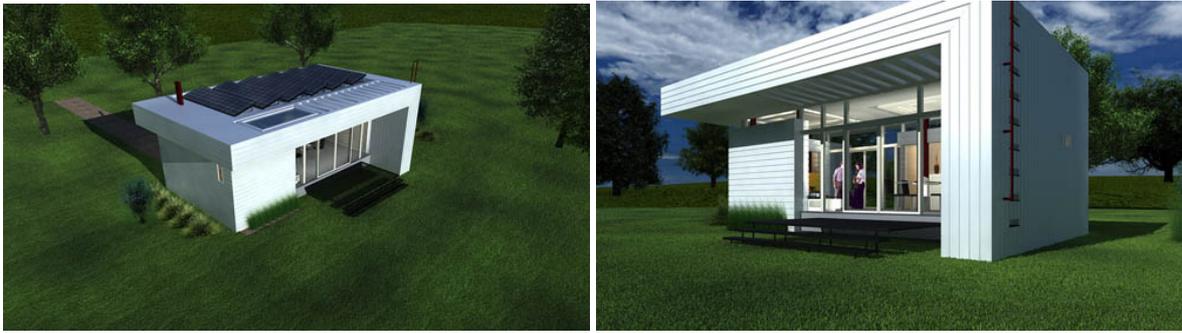


Fig.1: Stylish House design 2010.[6]

In architecture and the construction industry , nantechonology is capable of leading the building structure and architecture to an optimum level , for instance the coating of surfaces to lend them functional characteristics such as increased tensile strength , self cleaning capacity , fire resistance and many other capacities. Nanomaterials are not only useful for some partial requirements like roof and facades ;they also expand some design possibilities both for sustainable design strategies and architects . Nanotechnology on the near horizon , may take building enclosure materials (coating , panels and insulations) to a maximum capacity of performance in term of energy, light , security and intelligence. Even these first steps into the world of nanotechnology could significantly improve the nature of building structure and efficiency and the way our buildings relate to environment. The development of carbon nanotubes and other breakthrough materials could affect building design and performance. Brief definitions of nanotechnology ,nanobuildings, smart buildings , nanomaterials are the main approaches of this technology.[1] .

3. Nanomaterials Promote Green Architecture

Nanomaterials are prepared by clean energy and they can promote green architecture. Nanomaterials could work as a living skin which is not only green in terms of its functions but also in terms of its component. Nano construction materials are intelligent and of a versatile material system which adapts to structural loads and provide opportunities to develop self sensing capabilities in the material to achieve energy efficiencies and environmental comfort. This can be achieved by integrating the design process constraints with opportunities from emerging material and construction systems. This strategy enables each phase of the material system development to account for critical downstream design constraints constructions, scenarios and efficiencies needed for possible self sustaining system ,state this adaptive material system for the building envelope to optimize material use and to integrate additional functions such as self sustaining energy production and climate control.[2]. In the other hand ,nano living systems are seriously designed for public awareness to reduce energy consumption . Nano house design was expected to become the most efficient house design in electricity consumption to solve the problem of energy consumption. The sustainable nano living concept has been studied in recent years. These nanomaterials are basically made of carbon atoms .Some factors such as significant amount of carbon output is also being studied to know how much exhaust carbon these nano houses produce and how much this exhaust carbon affects environment . The nano living system study results indicated that the nano house exhaust carbon is still realistic or even has small effect on environment sustainability. These are biomimetic nanomaterials ,in other words solutions that are produced by studying and imitating the models in nature or being inspired by them: There are many products that have been produced after the feature of animals , plants or even organs and the way they function. [4]

4. Nanomaterial in Service of Economic Architecture

Nanomaterial can make constructions more economic because they are ten times lighter but hundred times stronger than regular materials .They focus on energy saving , productivity and protection. For example ,carbon nanotubes and other nano materials could so radically transform our material palette that paper-thin sheets might hold up entire buildings , forcing us to completely rethink the relationship between structure and skin. A material that acts like a piece of paper in many ways, but one that brings with it so many new and exciting possibilities is grapheme. It will, with no doubt have a multitude of impacts upon the

built environment. And significant among those will be on the evolution of surface. Carbon nanotubes-sheets of graphite just one atom thick ,are already the building blocks for hundred of applications , used to reinforced concrete and deliver medication to individual cells. Nanocomposites , which combine new nanomaterials with more traditional ones such as steel , concrete, glass , and plastics, can be many times stronger than standard materials. Already on the market is a nano composite steel that is three times stronger than conventional steel . In the near term , nano composite reinforcement of steel , concrete , glass , and plastics will dramatically improve the performance , durability and strength-to weight ratio of these materials . Before long , nano-reinforced glass might be used for both structure and enclosure. Nanotube structural panels could make some opportunities to create transparent load bearing curtain walls free of columns and beams .Quantum dots make walls and ceilings light up or change color with the flip of a switch, and nano sensors in building components create smart environments that constantly adapt to their environment and users. Already, this new science of the small particle has brought self cleaning windows , smog-eating concrete , and toxin-sniffing nanosensors to the market. About three hundred nanoengineered products are commercially available in the world. But these off –the-shelf advances offer only a taste of what ‘s incubating in the worlds nanotech labs today. There work is under way on nanocomposites as thin as glass, yet capable of supporting entire buildings , and photosynthetic coating that can make any building surface a source of free energy. These remarkable effects are achievable because matter behaves differently at the nanoscale , where the laws of quantum physics take hold . In this quantum world , objects can change color , shape , and phase much more easily than at the macro scale. Fundamental properties like strength ,surface-to-mass ratio, conductivity and elasticity can be engineered to create dramatically different materials which have real economic concerns.

5. Acknowledgement

Nanomaterials make opportunities to have smart buildings. Traditionally , the design and construction of building envelopes involve the use of multiple layers of different materials to achieve a wide array of functionalities , including strength , light filtering , thermal insulations , sound insulations , weather resistance and architectural appearance .How ever this layering approach introduce inefficiencies and also create a number of joint and interface , which ultimately act as weak links in the building envelope causing durability problems.[5]. Surely new materials and fields of use will bring new forms and functions to designs and there will be new dimensions in human structure environment relations. Architects who have come to be familiar with nanotechnology use products and systems that are lighter but stronger , environment friendly and those that can clean both themselves and the air , and so can design more sustainable buildings. In future ,steel or bricks will not be used in buildings . And this will provide many different design opportunities for the architects and designers. The conceptions and the practice of architecture will change. Nanotechnology ‘s “wonder materials “ have the potential to revolutionize how and what we build. Privacy , sustainability and security are just a few of the issues that will be profoundly affected by nanotechnology. As threats from terrorism and even from natural forces like hurricanes rise , we will utilize the strength of nanotubes to make our buildings more secure. The design and construction of buildings will incorporate rich network of interacting , intelligent objects, from light-sensitive , photometric windows to smart appliances . Buildings will not be static but will change constantly as their components continuously interact with users and each other .These dynamic environments will be almost organic in their ability to respond to change. Therefore with these new materials architects can design dynamic buildings which are more beneficial.

6. References

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