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Study and research on the possibility of benefitting from nanotechnology in architecture design of buildings of tehran city with emphasize on the viewpoints of construction industry specialists and experts

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A R T I C L E   I N F O

A B S T R A C T

Nano is extracted from the Greek word of "Nanos" meaning midget. Nanotechnology defines the behavior of materials in nanometer scales (m10-9), and in this scale, the materials behave completely different from the behaviors perceived in the macro scale as much as today, the researchers and industrialists in nano field try to use this technology to create optimized materials to be used in construction industry. The present paper has aimed at knowing the degree of knowledge of the construction industry engineers and experts on nano application in developing buildings, as the initial ground for its development and promotion in the society. In typology term, the research is descriptive-analytical and in the category, it is an applied research. The statistical society of the research consists of all members of Engineering Association Organization of Tehran. 332 of the members of mentioned Association were selected systematically at random by using Cochran Formula and were questioned directly by using questionnaires as data collection tool. The collected data was analyzed in SPSS software environment and was tested by using a comparative single T test. The results of the research showed that the mean average calculated on the knowledge of construction industry engineers and specialists in this city on the proportion of applications of processed materials by using nano was slightly more than the expected mean average.

1. Introduction

Due to irregular consumption of irreversible energies and the environmental damages, the situation of world energy is in critical conditions and finding solutions for it could open path for sustaining and saving environment for the future generation. The application of nanotechnology in the abrupt changes of other technologies has high impacts on people's health and welfare. Today, by benefitting from nanotechnology and its conjugation with other specializations, different countries have made some achievements in this field such as lower production and maintenance costs, lower energy consumption and higher life span (W.Zhu 2004). In the area of energy, nanotechnology is capable of considerable effects on the efficiency, saving the reserves and generating energy and could lower energy consumption. With respect to major changes which are expected in the next 10 years in the illumination technology (Zahedi, 2012), it will be possible to produce large amount of semi-conductors that are used in L.E.D. abundantly in nano dimensions (Serrano, 2009). In the United States of America, almost 20 percent of total electricity which is generated is used for illumination by ordinary light bulbs and fluorescent bulbs (Nanoforum.org2009). According to the forecasts, in the next 10 to 15 years (Lipowsky, 2001) progresses of this type could lower world consumption for more than 10 percent, leading to 100 billion dollars saving per year and 200 million tons decrease in carbon diffusion. Therefore; to find a substitute for fossil fuels with compatibility to the environment, nanotechnology provides practical methods so any inexpensive material such as paint could be converted into solar battery (Hersam 2000:61-80). In this respect, cost effective production and high efficiency are among other demands of researchers in producing processed materials. In this approach, steel, glass and concrete have the highest share. Application of nano particles in construction industry, with carbon nano tubes (CNT) (Campillow:215-226) and titanium dioxide (Tio2) as the most important substances, usually cause an increase in the mechanical properties of samples in major structures; and in finishing parts too, nano application in internal parts and external façade of buildings are of particular importance. In future, the biggest plans in making surrounding environments will be very very small. The small plans presented in nano technology category and its effects on the structure of surrounding environment of people could be discussed in the two chapters of role of nano technology in designing today architecture and its achievements in the next 15 to 20 years. Due to the changes which have already taken place, there are presently a number of materials with nano engineering structure available to the architects and developers to be used in buildings and the changes and evolution of buildings by using those materials are subjects of many discussions.

Some of the examples of products that are being produced include thin and transparent scratch proof layers for protecting windows that are self cleaned by receiving sun UV and rain; glasses that change their color by decrease or increase in environment temperature and adjust the light and concretes resistant against impacts and cracks; though these products are so expensive that they have not reached mass production so far. Of course, the nano specialists are trying to produce carbon tubes with unique strength and flexibility for buildings and directing towards manufacturing new forms, in giving news on new functions and modern communication between people, buildings and surrounding environment. Although in future perspective, the overall effects of nano technology in human life and his connection with the surrounding environments and buildings will be inevitable and unimaginable, the social, moral and environmental changes will not stay untouched by this evolving path either. (Elvin 2003:19).
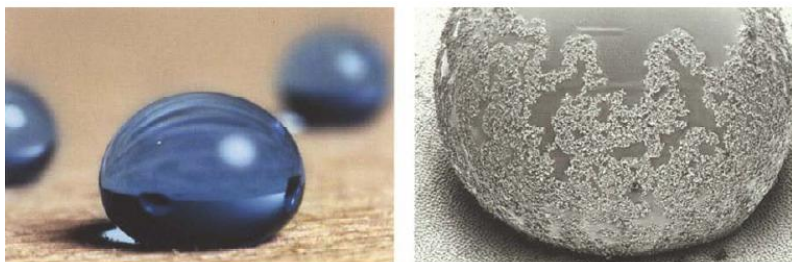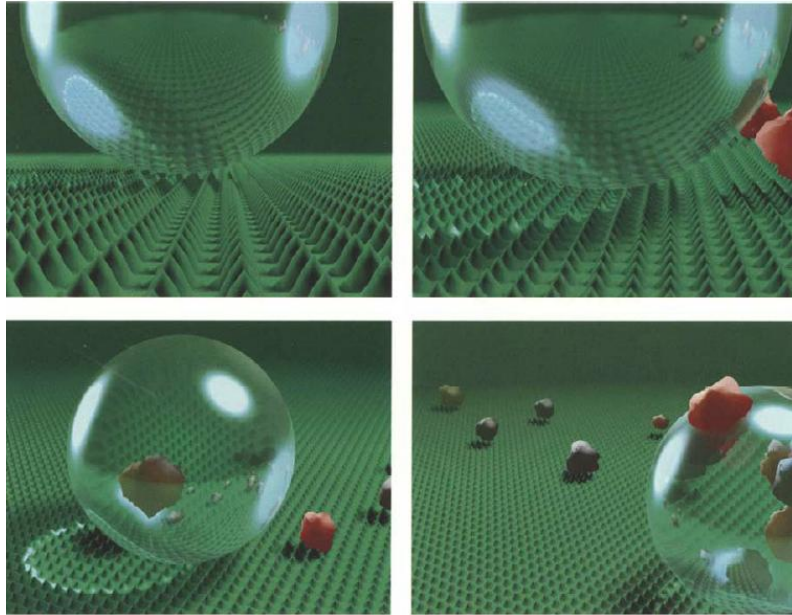
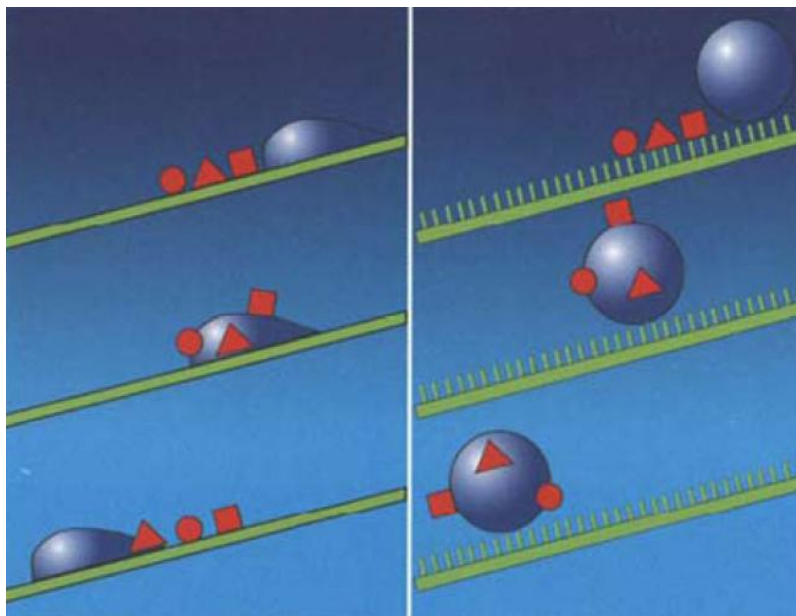**Fig. 1.** Dust and dirt absorption of the surface by water particles.

Fig. 2. Comparing the water flow on two surfaces, one of them coated with a nano metric layer of gum substance and the other is produced in ordinary method.

Today, with respect to acceptable advancements in nano technology development (Oriakhi 2004:57) in the scientific centers of the country, and the economic, social changes of the present society of Iran, the necessity of moving towards making changes in traditional dimensions, particularly in construction and housing production has revealed itself; however, there are some problems and difficulties in this regards, among which, one may note the managerial challenges (Forghani and Ansari 2007:6) in the country, such as:

- No proper definition of the projects that are related to marketing, market forecast and technology
- Limited number of commercial applications of nano technology against the number of ideas that are still in research phase

- Negligence in employing a multi-disciplinary team consisting of scientists, engineers and managers; and other associated specialties
- Absence of specifying the special place of intellectual ownership rights
- Dealing with legal bodies to receive necessary permits and general ignorance on this specialized work.

The present research tries to assess the knowledge of specialists and experts associated with construction in Tehran City, as the most active urban zone in the country that has attracted a large volume of capitals of private and governmental/public sectors in applying different types of nano technology in construction industry as a base for developing and promotion in the society that could be a great help to the decision makers in solving problems they face in applied development of this type of materials (Silvia 2006).

2. Materials and methods

In terms of nature, subject and goals that are foreseen for the paper, it is descriptive-analytical and is among applied researches. Since, questionnaire and interview tools are used to collect the necessary information, from another aspect, this research could be also known as a survey- field research too. The information needed to conduct this research has been collected in the two forms of literature review and field study. The statistical society of this research consisted of all members of Engineering Association Organization of Tehran city with specialized majors related to construction industry. By using the inquiry tools and employing Kokaran formula, 332

$$n = \frac{N t^2 S^2}{t^2 S^2 + N d^2}$$ samples were selected by simple random method and were inquired directly. The variables of this research consisted of the amount of knowledge on the processed constructional materials and the level of specialized knowledge of engineers and specialists on the applied characteristics of this type of materials in developing buildings such as: (increase in façade resistance against UV absorption, discharge of materials water, decrease in dirt and environmental pollution absorption, constructional materials resistance against fire, auto-cleaning materials and energy control). The variables were tested by using SPSS software and the tests for comparing the mean averages [One Sample Test T].

3. Results and discussion

The initial hypothesis of this research considered low specialized knowledge level of construction industry experts on the applied characteristics of materials processed by nano in buildings of Tehran City. In order to test this hypothesis, 6 questions were developed on the amount of knowledge on nano applications in following items:
1. The amount of knowledge with nano application in improving the building façade resistance against UV absorption by optimized products
2. The amount of knowledge on nano application in discharging water in the optimized materials
3. The amount of knowledge with nano application in lowering the absorption of dirt and environmental pollutions absorption in case of using processed materials
4. Amount of knowledge on nano application in benefitting from auto-cleaning glasses
5. The amount of knowledge with nano application in energy control by processed materials

3-1) Based on the results from questionnaires and the total 332 statistical samples who were questioned, the highest abundance in age group category was in 20-30 years age group (43.7%) and 30-40 years old (35.8%); respectively and the least frequency was in the 50- 60 years and older age groups.

In addition, the results showed that the education level of this society was high school diploma (18%), associate degree (28%), bachelor's degree (30%), master's degree (18%) and Ph.D. (6%).

3-2) With respect to the data extracted from 332 statistical society, their major of studies were: Civil engineering (34.6%), architecture (20.5%), urban development (16.3%), building restoration (13%) and other relevant majors (15.7%); respectively, constituted our statistical society and the occupation of the individuals of the statistical society were civil engineers (34.3%), architecture engineering (20.2%), urban developing engineer (14.5%), buildings restoration (9.9%) and other relevant majors (21.1%); respectively.

In addition, the results extracted from the questionnaires of the statistical society showed that the position of the individuals in statistical society with respect to their position were: advanced technicians (22.9%), expert (17.8), senior expert-engineers (25.9%), in-charge of the section (27.4%), and chief of the section (6^); respectively. In addition, the cooperation records of those people in construction industry area were 1 to 5 years (32.8%), 5-10 years old (13.9%), 10 to 15 years (22%), 15 to 20 years (26.2%) and + 20 years (5.1%); respectively.

3-3) One of the most important issues studied in this research was the amount of knowledge of the specialized statistical society in construction area on nano technology and in 39.5% of the above-mentioned statistical society, high knowledge was found on nano technology, and only 1.5 percent of the above-mentioned statistical society had least knowledge on this science.

3-4) Extraction of collected data showed that 36.6% of the concerned statistical society had average and sufficient knowledge on the construction materials processed with nano including: the nano- pains, strong concrete- nano glasses, façade stones, paper walls…and only 8.3% of the above-mentioned statistical society had limited knowledge in this area.

3-5) In addition, analysis of the information collected from 332 statistical society samples revealed that 61.5% of the existing statistical society had sufficient information on optimizing construction materials by using nano technology and only 38.5% of this society had limited information in this area.

3-6) With respect to high specialty of the existing statistical society in construction industry and understanding the present conditions of construction development in the country, and after studying the views, 55% of the statistical society believed that using nano technology in Tehran city was necessary and 45% of the above-mentioned members of the above-mentioned society did not see it necessary or effective to use that technology in the building designs of Tehran city.

3-7) The results from analyzing the questionnaires showed that 70% of the statistical society believed that the absence of technology was the major factor in not using that technology in the country.

3-8) The results obtained from analyzing the questionnaires showed that 65% of the statistical society believed that high expenses and low economical justification to be the main factor in not using that technology in the country.

3-9) The results obtained from analyzing the questionnaires showed that 55% of the statistical society believed that lack of knowledge and insufficient information of people on the technology as the main factor of not using this technology in the country.

3-10) The results obtained from analyzing the questionnaires showed that 63% of the statistical society believed that lack of grounds, conditions and areas were the main factors in not using that technology in the country.

3-11) In addition, results obtained from analyzing the questionnaires showed that 50% of the statistical society believed that low price of energy carrier consumption in the country as to be the main factor in not using this technology in the country.

3-12) The results obtained from analyzing the questionnaires showed that 66% of the statistical society believed that sanctions and existing restrictions as to be the main factor of not using this technology in the country.

3-13) The results obtained from analyzing the questionnaires showed that 60% of the statistical society believed that absence of legal requirements in urban structure plans as main factor in not using this technology in the country.

3-14) The results obtained from analyzing the questionnaires showed that 37% of the statistical society named the loss of national identity and independence of architecture culture as the main factor in not using this technology in the country.

In conclusion, the results from extracting 332 questionnaire mentioned above, the information of which is shown in diagram number 1 reveals that the highest amount of knowledge of the addressees members of engineering association organization of Tehran (with 50.4% of answers) were on their "knowledge on application of nano in producing construction materials to control energy in buildings" and the least amount of knowledge on using processed materials was on "absorbing dirt and reducing environmental pollutions" with 28.8 percent. Despite the initial assumption that considered the knowledge level of members of the association in this issue as to be low, the results showed that their knowledge was a little higher than anticipated mean average. This means that despite relatively suitable scientific activities that have been carried out in recent years for developing

knowledge and relevant technologies across the country, unfortunately, the users of the products of this technology do not have much familiarity with the properties and applications resulting from using those technologies and this issue doubles the necessity of informing in this regards.
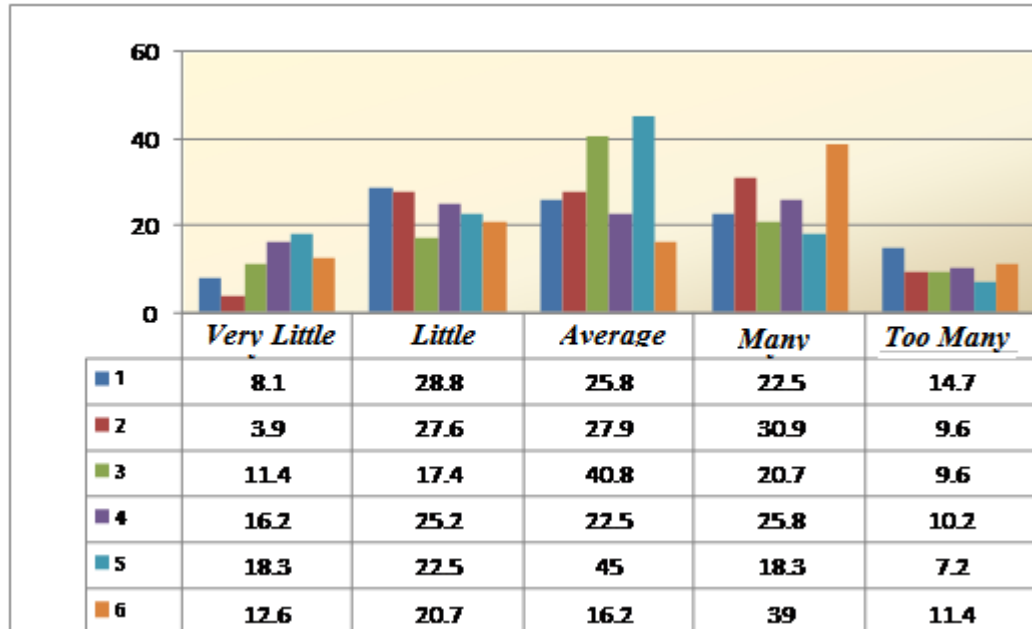

	Very Little	Little	Average	Many	Too Many
■ 1	8.1	28.8	25.8	22.5	14.7
■ 2	3.9	27.6	27.9	30.9	9.6
■ 3	11.4	17.4	40.8	20.7	9.6
■ 4	16.2	25.2	22.5	25.8	10.2
■ 5	18.3	22.5	45	18.3	7.2
■ 6	12.6	20.7	16.2	39	11.4

Fig. 3. The diagram of the number and frequency percent of responds of the statistical society to the research variables.

The single comparison test Results (T) showed that the mean observed was 18.26 percent higher than the mean anticipated in the research, 17.5 percent; as a result, the initial hypothesis on low knowledge of experts and specialists of construction industry on different applications of nano technology in consturction industry is rejected in one percent error level in H0 area. This shows that the construction engineering association establishment and its associated members as the executive authorities in construction development in tehran had relative information in this regards which is not of course very desirable; as it did not have significant difference with the expected mean. Therefore, to promote and expand the use of these technologies in the constructionindustry of the country, followings are suggested:

Table 1

One-Sample Statistics		N	Mean	Std. Deviation	Std. Error Mean	
The calculated mean average of the research hypothesis based on the 6 questions asked		33 2	18.256 0	3.26440	0.17916	
				Test Value = 17.5		
One-Sample Test	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Mean anticipated based on the 6 questions of the research	4.2 20	33 1	0.000	0.75602	0.403 6	1.1085

T Single comparison of test results (source: findings of the research).

Suggestions

1. Establishment of educational workshops in national and provincial levels by inviting the members of engineering associations of different provinces of the country for information on the most recent achievements in nano technology in production of materials used in construction industry
2. Informing through advertisement teasers in public media, particularly in national media to improve the culture and creating demands in people and employers
3. Including courses on nano technology in university curriculums that are related to construction industry for students' more familiarity with its different aspects in order to use its capabilities in future executive projects extensively
4. To hold national and regional congresses and conferences to present expertise viewpoints and opinions on the advantages of using nano technologies in future constructions with respect to the changes emerged through omitting energy carriers in the country
5. To develop specialized exhibitions with the approach of nano materials in construction industry to pave grounds for informing the activists in construction sector across the country.

References

Campillo, I., Dolado, J.S, Porro, A., 2004. High performance nanostructure materials or construction. Nanotechnol. Construct., P.J.M. Bartos et al. Eds.(royal society of chemistry– ISBN 0-85404-632-2) 215-226.

Elvin , G., 2003. Nanotechnology, the Miami Herald,19.

Forghani., Ansari, A.R., 2007. Study the Necessity of Developing Nano Technology and its Managerial Challenges in Iran, Vol. 3, Technol. Growth, 6.

Hersam, M.C., Guisinger, N.P., Lyding, J.W., 2000. Silicon-based molecular nanotechnology, Department of Electrical and Computer Engineering and Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, Illinois 61-80, USA

Lipowsky, R., 2001. Biomimetic materials and transport systems, European white book of fundamental research in materials science,max-planck-institut fur mettallforschung styttgart,78-82.

Nanoforum, O., 2003. nanotechnology helps solve the words energy problems.

Nanotechnology : available.

oriakhi, C.O., 2004. commercialization of nanotechnologies", masters thesis management of technology ,MIT, Massach. Inst. Technol. Manag. Technol. Progr., 57.

Serrano, E., Rus, G., Garcı., et aJ., 2009. Nanotechnology for sustainable energy, Molecular Nanotechnology Laboratory, University of Alicante, Carretera Alicante-San Vicente s/n, E-03690 Alicante, Spain ,pt. Structural Mechanics, University of Granada, Polite´cnico de Fuentenueva, 18071 Granada, Spain, 11-12.

Silvia, E.d., 2006. Nanotechnology Science, Www. Nanotechnol. com.

W.zhu, P.J.M., bartos, A.P., 2004. Appl. nano technol. Construct., (summary of a state – of – the – art report), 5.

Zahedi, A., 2012. Personal internet site, Industrial Engineering. System. Plann. Analysis.