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Feasibility of Smart Façade Design in Schools of Temperate and Humid Climate of Iran in order to Reduce Energy Consumption

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Abstract. There is no doubt that one of the most controversial issues and challenges of the present century throughout the world is the issue of energy. In general, there are many ways to preserve energy resources. The most common method is through a culture of savings. The latest idea to save energy is using new equipment and systems that have been considered for this purpose. Intelligent systems in the building's façade are a part of this method. Since the thermal shell of the building is responsible for the waste of energy in buildings, focusing on the sector could help to reduce energy consumption. Because their design, the shell of the building (i.e. windows, walls and doors) is in direct contact with the outside world and has an important influence on thermal comfort and visual comfort and energy consumption of the building. Facade design of educational buildings, especially schools, is a different challenge than the facades of other buildings. Given that education in schools is smart, it fits better that the educational environment be smart as well. Therefore in this article we are introducing the smart systems and materials and at the end, a new smart system will be introduced to be used in the façade of the smart schools based on temperate and humid climate. The method used in this research is survey method and the resources are documents.

Keywords: Smart Materials, Smart Systems, Smart School, New Equipment and Systems

1. INTRODUCTION

Buildings and live in them over the last two decades has changed. In fact, we can say that except for a few exceptions, the current building is not the kind of habitat that belongs to the current life. (Gorji Mohlabani, Haj Aboutalebi, 2009). Intelligent architecture is one of the discussions about the construction of the space in which it is turned to live and respondent entity. The increasing consumption of energy, exhaustible resources, and sometimes irreversible adverse effects of excessive consumption of energy on the environment and its increasing price in recent years is motivated the authorities and consumers for looking for ways to save energy and the proper use of energy. Today, intelligent building management systems have an important role in energy conservation, by reducing the costs of construction and use of new technologies. With the implementation of these systems costs can be rectified in a short time. (Alikhani, 2001).

In recent years due to the growth and extent of changes in educational methods, adapting learning platform for all aspects of learning needs, is in the spotlight of teaching specialists. The physical environment due to their structure and the learning process can strengthen or weaken interactions. And on the other hand not only the international community but Iran is now faced with the reduction in fossil fuels. So to solve this problem, the scientists sought to use the natural energy and environmental problem-solving methods.

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Intelligent buildings are to reduce energy consumption and due to environmental changes they show different reactions. These reactions enable them to use smart material wisely. So Smart School because of the tools and technologies is a good place to use smart system architecture. To take steps in order to reduce energy consumption. And also because students are introduced to the ways to reduce energy consumption, new technologies and their application from their childhood and they can take some important steps for introduce them to the society and to make smart buildings a tangible concept and make this culture in the society. In this way, through a general awareness the society goes the direction toward reduction of energy consumption and the energy shortage is resolved. Therefore this study aimed to assess the readiness for the application of smart schools in temperate and humid climate in regard with the principles, tools and materials to reduce energy use through smart architecture. In this line the main question of the research is as follows:

To what extent it is possible to use smart materials and intelligent systems in educational buildings (smart school) at the temperate and humid climate?

2. REVIEW OF LITERATURE

Studies show that this technology is not unfamiliar in Iran, as in Table 1 mentions some examples of research in this field. In many cases, some of these systems have been used. But as they have not been popular, and many other functional materials and systems still have not been properly introduced. In order to introduce all of them to Iranian society, a lot of study shall be performed and the objective of this study is to introduce some of this materials and systems. Applying them in smart schools is another step toward reducing the costs and most importantly reducing the consumption of non-renewable energy.

Table 1. Summary of Relevant Literature.

	Author	Title	Result
1	Bagheri et al.	Smart school design with an emphasis on smart education in the schools with the approach of sustainable architecture (2013)	Using smart walls and floors and smart façade and placement of collectors and Photovoltaic in the schools, the possibility of training with innovative technology and intelligent education and provides stability of training in schools
2	Gorji Mohlabani and Haj Aboutalebi 2009	Smart Materials and Their Rule in Architecture	Optimization of energy consumption in buildings, designing buildings with feature of high durability against climate, increased demand and productivity in the future
3	Bonab and Memari (2011)	Smart Materials Application, a New Step toward Sustainable Development	Introduces smart materials and thus the possibility of this type of material in cold and mountainous climates, and is very effective in reducing energy consumption.
4	Raeisi (2012)	Sustainable Architecture in Design of Educational Spaces	The use of clean energy was common in our previous architecture and using new technology and integrating it with climate architecture, it will have a significant impact on future energy consumption pattern
5	Seyedian et al. (2013)	Using Smart Materials in Future Architecture, a step toward sustainable architecture	Now the technology is available for smart buildings and smart materials are future introduced in this research and it reports that for more general use of this materials more research, standardization, and investment in research and is required.
6	Daneshvar and Imeni (2013)	Assess the Impact of Smart Materials on Sustainable Architecture	Using nanotechnology and change in technology of using solar energy may lead to deduction of costs of solar energy supply and increasing the technical efficiency and solar energy dynamics. Using the strong materials can increase the useful life of the building from 50 to 100 years.
7	Seyedian and Esfandiari Kenari (2013)	2 shells façade, a step toward sustainable architecture (Examining the functioning of 2 shells façade in humid temperate climate)	2 shells façade provides the possibility of natural ventilation through the air turbulences and its most important feature is its climatic agreement with seasonal needs. Among 2 shells façade, window box is suitable for temperate and humid climate.
8	Moeini et al (2010)	renewable energies and their role in energy supply	It introduces the wind and solar energy and its role in Iran's energy consumption and measures taken in the field of new energy deals in Iran
9	Movaghari and Tavoosi (2013)	Zoning and feasibility of potential locations for the deployment of solar panels based on climate indices in Sistan and Baluchestan Province	Sistan and Baluchistan is capable of deploying solar panels and the most talented cities are Saravan and Sibsavaran

3. MATERIALS AND METHODS

This study is a descriptive analytical research and data collection tools are the qualitative analysis of the concepts and theories of the data on literature and the samples were reviewed. After reviewing each one of the smart patterns and their functional analysis to use these patterns in architecture using similar researches and studies, we have tried to propose a design for smart schools using the introduced patterns.

Theories

Smart School

Smart School is an educational organization with physical and natural existence (not virtual) l in which students are taught with new methods. In the Smart School, control and management is based on computer and network technology, and the content of its curriculum is electronically and its evaluation and monitoring systems is smart (Education Department of Tehran, 2005). Since new teaching method was common for a few years in Iran, but so far it failed to be enforced properly. There are many reasons involved including lack of educational opportunities tailored to the new educational system. One of the things that can coordinate the educational space with technology is a smart architecture. Application of this principle is not only makes a space that helps the implementation of the new education system, but also helps to solve the problem of reducing the use of fossil fuels that is one of the challenges in today's world. Smart architectural includes smart systems and materials and each one of them has a variety of numerous types and deal with all of them is beyond the scope of this article. Based on the performed studies in field of smart systems and smart materials in Iran that some of them were mentioned before, some of the systems and materials are introduced therefore it can be seen that this technology is not entirely unknown and using them in different projects and specially in public and private buildings can introduce them to the society in a tangible way. One of the options in this regard is using smart systems in schools and therefore we will introduce some of the practical systems for temperate and humid climate.

Smart Architecture

Organic architecture is introduced by Frank Lloyd Wright as adaptation of buildings based on their insertion in nature. Today this will be discussed in sustainable architecture and new horizons, intelligent architecture with smart materials and nanotechnology. Since using the achievements of smart materials in one object (building) in different times and places, it can show different behaviors (hard or soft, fluid and flexible), theories of knowing the materials in general are changing. In fact, the materials lose their permanent identity and architecture definition will not be limited in time and space. A smart building is a building that thinks and evaluates its needs and tries to eliminate them. In order to have such a building, the smart materials are the first and most effective factors (Mehregan, 2011). Nowadays, the buildings are

a form of technology. They adapt themselves with modern technology and use it. A smart building is such a building that enhances the efficiency and yield of its residences and provides the requirements of effective management based on the specific necessities and with the lowest cost (Afshari Basir, 2011). In US, a smart building is defined as follows: a smart building is such a building including a dynamic and cost effective environment that is made trough integrating the four main elements including the systems, structures, services and management and the relationship between them (El Sheikh – 2011). Smart architecture is dynamic. It means that the parameters change their main function based on the needs, and conditions. Smart architecture can also learn new experiences and use them in new condition such a living creature and due to this feature; the dynamic and self organizing is secured. The main features of smart architecture are as follows:

• Dynamics and activity
• Flexibility and adaptation to the environment
• Being reactive and responsive (Mofidi and Roshanzamir, 2009)

Smart Materials

"Smart materials" is a new expression for materials and products that have the ability to perceive and process environmental events and respond appropriately to them. In other words, these materials have the flexibility and ability to change the shape, form, color and their inner energy reversibly in response to physical and chemical effects of environmental change (Gorji Mohbalani and Haj Aboutalebi, 2009). If the material are divided into three groups: non-smart materials, semi-smart and smart materials, the first one, non-smart materials, does not have the above mentioned features, semi-smart is only able to respond to environmental influences and changes its shape and form for one time or a limited period of time. However, for smart materials this change is repeatable and irreversible (Ritter 2007). Smart materials are known as the "flexible" and "adaptable" materials. And this is because of their specific features to adapt themselves with environmental conditions. Chemical and physical variables are presented in the following, are drivers that the smart materials are responding to them:

Light, UV rays: ultraviolet and visible part of the electromagnetic radiation Temperature: temperature changes that a physical system makes in human body. Pressure: pressure difference created in one area.

Electric field: the created field around an electrical charge. Magnetic field: the field created around a magnet or a mobile.

Chemical environment: the presence of a particular chemical elements or compounds such as water (Afshari Basir and Afshari Basir, 2011)

Classification of Smart Materials

In general, the existing construction materials, such as: traditional, natural and artificial, are classified according to their characteristics, such as: the appearance, texture, chemical composition, mechanical and physical properties, environmental impact and so on. But for classification of smart material, in addition to considering the above mentioned items, some other features are considered that specifically divide the smart materials and traditional ones. In fact, the proposed classification for smart materials is provided based on 3 features:

Smart Materials Capable of Changing the Internal Properties:

Generally, the materials with its specific internal processes can show the following characteristics: waterproof the facade, cleaning the facade, improve the quality of air in the interior atmosphere, destroy the surrounding air pollution, noise absorbent, creating odor aromatic in the environment and including:

Shape Changer Smart Materials Color Changer Smart Materials Bounding Changer Smart Materials
Smart materials with an ability of energy exchange: Emitting Light Smart Materials
Electricity Producing Smart Materials
Energy Storage Smart Materials (Ritter, 2007)

The Introduction of Smart Systems and Materials

The smart materials and systems are distinguished. Smart materials are often small but vital part of a smart system. Most of the smart systems are a combination of the multi-functional smart

materials and components (Alikhani, 2001). The "smart materials" is a new term for materials and products that have the ability to perceive and process environmental events and respond appropriately to them. In other words, these materials have the flexibility and ability to reversibly change shape, form, color and inner energy in response to physical and chemical effects of environmental change (Gorji Mohlabani and Haj Aboutalebi, 2009).

Smart Systems

Photovoltaic Systems: Solar Cells (Figure 1 and 2)

Figure 1 and 2. Solar Cells.

Characteristics: convert solar energy into electricity energy that is renewable, usable in each climate, beautiful, least energy absorption equal to 25%, air conditioning, without any need to be moved, in harmony with nature

Advantages: 1. large savings in heating costs of buildings; 2- maintenance of heating near the surface of land; 3- lack of thermal difference on the ground floor and the roof

Disadvantages: 1- this system is very costly; 2- Because the climate is temperate and humid, it is mostly cloudy and rainy and the weather conditions prevented the solar energy. Therefore to adjust the heating of building, in addition to the photovoltaic system, mechanical installations is required for heating the building during the rainy and cloudy climate. In this way, using both options not only will not reduce the heating costs, it will raise it. 3- Lack of heat control – it is not able to respond to thermal changes. In Iran, the cost of converting solar energy to electricity is very high (IRR 250,000 to 450,000 per kW) (Masrouri, 2011), this system is suitable for places where access to national power grid is difficult and costly not for places with easy access to electricity.

Electro-Chromic Glass:

Performance of electro-chromic glass, switching electro-chromic glass condition from transparent to opaque, (Figure 3)

Figure 3. Performance of electro-chromic glass, switching electro-chromic glass condition from transparent to opaque

Reference: The website of Campaign for Development of Nanotechnology, 2013.

Characteristics

Their change in color is a result of electrical flows and it depends on the temperature of absorbing environment or the reflection of light and it changes from transparent to opaque mode. Their beauty and providing a comfortable environment, has a large economic impact on the per capita of energy consumption. Delia Milirioun, one of the active researchers in this field, says: "using these types of covers in the windows has a major rule in saving energy" and more importantly, she emphasizes that "these types of smart glasses do not use any specific hardware, therefore they are really cheaper than the current technologies.

Features:

Light control, privacy, UV protection, temperature and energy control, comfort and productivity, safety, strength, protection against noise

Smart Shell System with Central Mobile Lowers

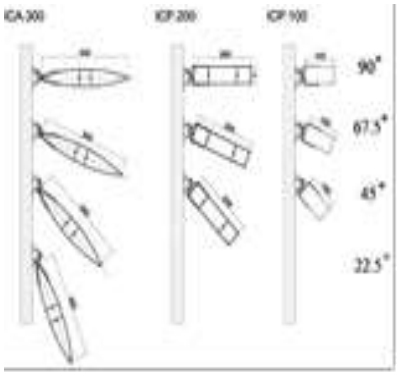

Figure 4. A house in west Glaxo.

Reference. Wigginton & Harris, 2002

Figure 5. 2 shells Façade System

Reference: Esfandiari Kenari, 2013

Characteristics

The 2 shells façade system is a structure including 2 surfaces (the outer surface is necessarily clear) which are separated by an empty space. The space serves as an air channel. It has an effective role in the acoustic and thermal insulation of the facade with two shells. (Kaveh, M.,

2011) Window boxes are suitable for temperate and humid climates because it will make the wind and natural ventilation (Seyedian and Esfandiari Kenari, 2013).

Aluminum
Lowers

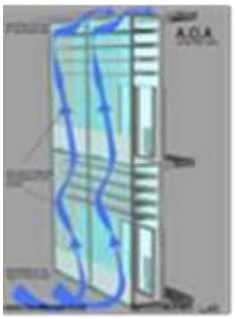

Figure 7. Installation Components of Lower Lowers **Reference.** http://c-s-p.ir

Figure 8. Different Shapes of Aluminum

Features: it provides shade against direct exposure of sunlight. Aluminum facades play a role in the systems with the ability to move electrically, mechanically or fixed dimensions and various types of decorative appearance. It has the most withstand power against wind speeds of over

150 kph. Lowers are generally in square, rectangular or conical shapes and using aluminum angles they are fixed on the main sheet or metal infrastructure and they are functioning remotely based on the movement of sun.

The Advantages of Aluminum Lower

Beautiful appearance, energy efficiency, control of direct sunlight into the building (permanently or at specific times), light control, ventilation control, creating a shield; perspective control

Application in Temperate and Humid Climate

In cold regions, the main goal is to use the direct natural light and heat of the sun as much as possible. But in the hot zones they avoid direct sunlight as much as possible. In temperate or subtropical areas, both issues must be considered. And lowers are selected in such a way that we can control the direct sun light according to different seasons (Ci Sakht Pey Company, 2015). They are suitable for moderate climate and applicable in the economy of Iran, and reduce the consumption of energy.

Vergola Roofs

Figure 8: Vergola Roof
Source: http://www.infolink.com.au

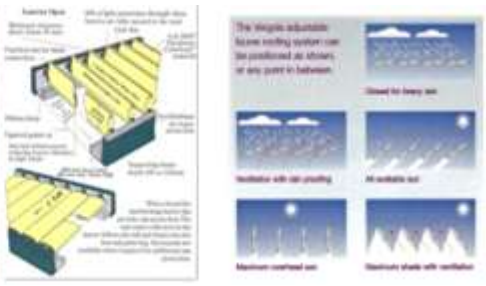

Figure 9: Function of Vergola Roof
Source: www.vergolansw.com.au

Features: Lets light into space, protects the environment against the light, activates the air conditioning or protection from the rain in an open area, and enables the residents to control their environment in all seasons and weather conditions. It can maintain a fixed temperature for the environment in the hottest day of summer; it also can protect the privacy and noises. Vergola is resistance against the hardest whether condition, wind and rain. When it is closed, the people are free to use the most of open space.

Application in Temperate and Humid Climate

Due to withstand rain, the main feature of the temperate and humid region, it can be used in this region.

Introduction of Smart Material

Where we are talking of smart materials the first thing that comes to mind is the impact of nanotechnology on the production of smart materials and Nano-based architecture. Most of smart materials are made by nanotechnology therefore in this section we will introduce some of smart materials that are produced in this way.

Nanosolar Panels

Figure 10. Solar Pannels under NANOSOLAR trademark have self-cleaning nano-coatings and are hydrophilic **Reference:** www.nanovation.com.

The panels are installed on inclined surfaces, roofs, facades of buildings and locations that are difficult to access and clean. Nano coatings covered on the mentioned panels, not only do not reduce transparency and efficiency, but also they can remove pollutants and dirt, dust, salt crystals, bird droppings, and in general, any disturbing factor between solar light and Photovoltaic panels, create the optimal performance and more efficiency for these structures. In addition, nano-based covers enhance the sustainability and durability of solar panels against Continuous exposure to sunlight (Haghshenas, 13)

Nano-Paints

Figure 11- (Picture on the right) using the self-cleaning paints, Palace of Germany (left pictured), anti-paint, anti-fat and anti-pollution at the German National Bank Building

Figure 11. (Picture on the right) using the self-cleaning paints, Palace of Germany (left pictured), anti-paint, anti-fat and anti-pollution at the German National Bank Building. **Reference:** (Golabchi et al 2011).

Features: Applied in liquid form on the surface, and gradually becomes dry and hard. It is scratch-resistant, anti-abrasion and it has high hardness, excellent gloss and color stability (Golabchi et al., 2011). Self-cleaning quality colors are one of the main features. The self cleaning paints are so thin therefore they are completely transparent and do not change the visual quality (Alikhanzadeh, 2013).

Self-Cleaning and Easy Cleaning Glasses (Photo Catalyst)

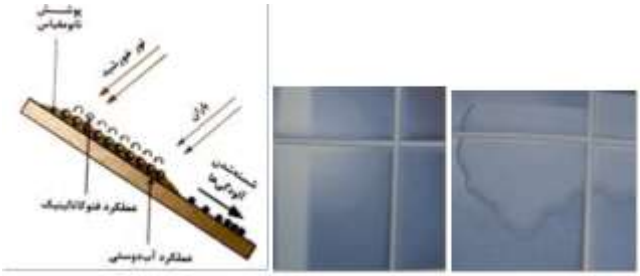

Figure 12. The function of self-cleaning glass with photo catalyst features.
Reference: Golabchi et al (2011)

Features: In these glasses, the effects of photo catalyze is used for decomposition of bacteria, fungi, pollution and other factors that pale glass. The quality of self-cleaning in these glasses is possible through the use of coatings with nanometer thickness (about 15 nm), which are transparent and have the simultaneous hydrophilic and photo catalyze effects (Golabchi et al., 2011).

Anti Fingerprint Surfaces

Figure 13. The Result of Using the Anti-Fingerprint Coating On the Right Surface
Reference. Leydecker.2008

Using anti-fingerprint coating can remove the signs of a touch of the finger on the surface. The new coating not only reduces fingerprints, but also it minimizes the possibility of dust on the surface (Golabchi et al. 2011).

Anti Graffiti and Writing Coats

Figure 14. Brandenburg Gate Historical Building in Berlin is protect against graffiti and writing by nano-coatings.
Reference. Leydecker.2008.

Feature: create protective role for facades to prevent writing or inappropriate images on building facades or other constructions, causes the surfaces of materials to indicate the hydrophobic

behavior. This perfect hydrophobic behavior will enable cleaners to remove this paintings or righting from the surface easily (Golabchi et al, 2011).

Stone Nano Coatings

Figure 15. Decreased Ability to Absorb Moisture due to the Use of Nano-Based Water Resistance Coatings, and Followed by Reduce the Risk of Levee Moss and Algae Growth

Referene: www.nanovation.com

Features: Creates an invisible layer on the surface of the rocks with a special hydrophobic properties toward water and fats and oils, UV radiation, and antibacterial protection feature for stone (Golabchi et al., 2011). It penetrates in the structure of porous rocks and expand the scope of influence, after that the ability of anti-bacterial, anti-moisture and anti-heat will added to the stones to (Golabchi et al., 2011).

Strong Coating to Protect Wood from Weathering

Figure 16. Hydrophobic Properties of Wood with the Help of Nano Coating (right) residential villa – Erlen Bakh-Germany (left)

Reference: (Leydecker, 2008).

Characteristics

It is suitable for protecting the wood from weathering (especially in the denuded and outer space). These coatings have excellent hydrophobic properties which prevents the penetration of water to the wood and the adverse effects of rain. It is a perfect cover for wood against UV and prevents the change of color of wood due to sun (Golabchi et al, 2011). These coatings have the ability for breathing and steam penetration and therefore it is the best way of controlling the relative humidity of woods. Using this method the maximum protection will be provided for protecting wood (Golabchi et al, 2011).

4. DISCUSSION

The Possibility of Using Smart Systems and Materials in Smart Schools of Humid andTemperate Climate

We have a wide range of products and materials that are available or supplied in the market. Some of them are specifically produced for use in architecture and some others for applications such as textile industry, automotive, etc. But the key thing is how these new available materials will be used by architects and designers. If architects are able to get all the materials and products directly or as amended in projects, a huge flood of new and interesting possibilities

for the design of their building and the construction will be created. Creative architects can develop these materials and new products for special functions in architecture and they will be able to create a new industry in architecture based on new materials. Therefore architects will be more than the designer, they will be performer, producer and builder of these constructions (Addington& Schodek 2005). Considering the performed researches about smart materials and systems, some reasons are provided hereby for using or refusing to use them as follows:

1- Photovoltaic systems: since the function of this system is a subject of sun light to be economic, and considering the fact that this study is conducted in temperate and humid climate, this system is unable to provide heat for houses in rain, therefore it needs mechanical installations and it is very costly and it is incompatible with our aim that is to reduce energy use and fossil fuels. Thus, it is better does not apply them in this climate or at least in places like school.

2- Electro-chromic Glasses: based on their various advantages, the transparency of glass and relation with nature are very important for education, but this glass is opaque in front of sun, therefore it is better to prevent the use of this glass in schools or at least in classes.

3- Smart Sell System with Central Mobil Lowers: this system provides natural ventilation system that is the basic need in the design of buildings in this climate therefore it is very effective.

4- Climatic Lowers: considering the mentioned features they have no problem to be installed in this climate and schools but it will be better that their mobile type will be used to have the most fuction and make shades under direct sun light.

5- Vergola Roof: the mentioned features for these roofs shows its high function in temperate and humid climate and using these roofs will help the modern education objectives (flexibility and using open education area).

6- Nanosolar Panels: considering the mentioned facts in "1", using this panel is not economically justified.

7- Self-Cleaning Glass: due to high rainfall in the region buildings often need to clean their glasses and the use of this glass in buildings is very effective in having an adornment and clean appearance.

8- Strong Wood Protective Coatings: wood was traditionally used in the architecture of Mazandaran but nowadays, due to some reasons including reducing amount of woods and low strength of this material, its use in façade is radically limited and we can revive the native architecture using these coatings.

9- Stone Nano Coatings: Due to moisture and rain, algae grow often in concrete surfaces and have a negative effects on the beauty and performance of these surfaces. The use of stone nano-coatings has overcome these disadvantages.

10- Anti Painting, Writing, Graffiti, Fingerprint Coatings and Nano Paints: considering the fact that school is a public place and a lot of students are present there, these coatings may make schools a safer place and reduce the costs of maintenance.

Compare and Final Results

The study was compared to studies in the world literature that was provided at the entrance of the study and it shows that in the temperate climate of northern Iran, the use of nano solar panels and photovoltaic systems is not possible. This finding is in line with the studies performed by Movaghari and Tavousi that investigated the likely places to use the solar panels in the province of Sistan and Baluchestan but it is in contrary with the results of Bagheri et al in their study entitled designing smart school with emphasize on sustainable architecture. The reason is that considering the fact that even in Sistan and Baluchestan that has hot and dry climate, all of the places are not suitable for installation of solar panels, this situation is worth in Mazandaran that has quite less sun light. Therefore, using the solar systems is a subject of climate and place of use and they cannot be applied in all places such as schools that are public buildings. These panels are costly.

The results of Bagheri et al (2013) and Gorji Mohlabani and Haj Aboutalebi and others (2009) indicates that using smart materials has had a considerable impact on reducing energy consumption that this is pretty much in line with author's opinion. But it seems that using this technology is not suitable for classrooms because it will be opaque under sun light and it is in contrary with the objectives of smart schools in which transparency and having relationship with nature is important. Therefore other techniques and materials may be used to control the sunlight in the classroom.

The results of this study are in line with the findings of Mr. Seyedi and Esfandiari (2013), which believed that the use of double-shell façade systems in temperate and humid climate is possible.

No study is performed up to now about lack of function and using the aluminum lowers and vergola roofs and based on the characteristics and features of these systems it seems that these

systems are suitable for the temperate and humid climate, especially for school and provide a suitable environment for education.

The studies about using nano technology and smart material such as self-cleaning glasses, wood protective coatings, stone nano coatings, anti graffiti and writing coatings, anti fingerprint coating and paints are performed by Gorji mohlabani and Haj Aboutalebi (2009), Bonab and Memari (2011), Seyedian et al (2013) and Daneshvar and Imeni (2013) and it seems that based on the features of these materials, the use of these materials is effective in providing a healthy school environment and reducing costs in the long run and it is very economical and is aligned with the author's opinion.

5. CONCLUSION

In field of modern architecture, a new technology is introduced in daily basis and the developed countries are competing with each other in using them. Using these technologies is obvious in Iran but its process is very slow. The main reason is its high primary costs in time of implementation but this is not a good reason to prevent the using of these technologies. What motivates the world to use the new energy and new technology is likely to be several reasons, including the following: reduce the use of fossil fuels, adverse effects that these fuels have on the environment, lower energy consumption, reduce the enormous economic costs in the long term, the beauty of the monuments and buildings that leads to an elegant, beautiful and clean city. Iran is not an exception to this rule but because of cheap fossil fuels, delays the use of this technology. One thing that is very effective in the application of these systems is culture and in addition to promotion in this field, these techniques shall be used in practice. Their main function is in construction and one of the buildings is educational places that are a good candidate for energy efficiency. The first reason is that with reduction of energy costs, we

can use more resources for educational purposes. The 2nd reason is that observing savings guidelines is a practical training for the students that will remain in their minds and will extend to the society. The 3rd factor is necessary peaceful environment for educational purposes. With more peace in these places, the higher educational quality can be gained and energy efficiency in existing buildings and in the future buildings is very important. Thus, using the new technologies will help us in achieving the above mentioned objectives.

REFERENCES

[1] Afshari Basir, N., Afshari Basir, M. (2011), "Intelligent Building Step Toward New Technology".

[2] Alikhany, H., (2000), "Smart Windows", The First Conference on Energy Conservation in Buildings

[3] Alikhanzadeh, R., (2013), "Paint Production Technology" <www.shasa.ir> Last Updated January 15, 2014

[4] Bagheri, I., Bemanian M., and Keshmiri, H., (2013), "Designing the Smart School with an Emphasis on Smart Education in the Schools with the Approach of Sustainable Architecture" the first national conference on architecture, restoration, urban planning and sustainable environment.

[5] Daneshvar Z., and Imeni, Z., 2013, "Evaluation of the Impact of Smart Materials on Sustainable Architecture," the first national conference on architecture, restoration, sustainable urban environment, September 2003

[6] Education Department of Tehran, 2005, Roadmap of Smart Schools p. 8.

[7] El Sheikh , Mohamed , (2011) , " Building Skin Intelligent : A parametric and algorithmic tool for day lighting performance design integration" , A Thesis Presented to the faculty of the USC school of architecture university of southern California .

[8] Flower-M. persianblog.i, Mina Masrouri, 2011, art and puzzle website-last update on May 22, 2015, a special committee of nanotechnology extension, www.nano.ir- last updated on February 9, 2014

[9] Golabchi, M., Taghizadeh, K., Soroushnia, E. (2011), "Nanotechnology in Architecture and Engineering", Second Edition, Tehran, University of Tehran Institute

[10] Gorji Mohlabani, Y., and Haji Aboutalebi, E., (2009), "Smart Materials and Its Role in Architecture", Journal of Housing and Rural Environment, Vol. 28, No. 127, pp 66-81.

[11] Haghshenas, M., (2008), "The Use of Nanotechnology in the Manufacture of Photovoltaic Cells with High Efficiency", the National Congress of Fuel, Energy and the Environment

[12] Kaveh, M., (2011), "Examining the Technology of The Two Shells Façade (DSF) in Terms of Reducing Energy Consumption in Buildings", Journal of Civil House, the first, second and third numbers, fall and winter 2011.

[13] Lydecker S., (2008): Nano Materials (in Architecture , Interior Architecture and Design), 1st edition, Berlin, Germany, Birkhauser, Addington, D. Michelle; Schodek, Daniel L. (2005). "Smart Materials an Technologies for the Architecture and Design Professions", Architectural Press/Elsevier: Oxford.

[14] Mehregan, M. (2011), "Smart Materials and the Need to Changes the Use of the Nature(Supply of Required Green Materials)" Regional Conference on Architecture and Building Materials", Educational and Cultural Center of Sama University of Sari.

[15] Mofidi, M. and Roshanzamir, Sh. (2009), "Smart Shell", Abadi Jurnal, No. 63, pp. 128-133, Tehran, 2009

[16] Movaghari, A., Tavousi, T. (2013), "Zoning and Feasibility the Potential Locations for the Deployment of Solar Panels Based on Climate in the Sistan & Baloochestan Province", Journal of Planning Research and Energy Policy", (1) , Spring 2013, pp. 114-99

[17] Raeisi, E., 2011, "Sustainable Architecture in the Design of Educational Spaces, Case Study: Aghabozorg Schools and "Clear view Elementary School Canberra Primary School", the modernization and equipping of schools in the country, 13,303-specific code.

[18] Ritter, Axel, (2007). "Smart Materials in Architecture, Interior Architecture and Design", Birkhauser, Switzerland
[19] Seyedian, A., Esfandiari Kenari, M., 2013, "2 Shells Façade, a Step toward Sustainable Architecture" (examine the functioning of view of the two shells in humid and temperate climate)" Conference on sustainable development and urban architecture.
[20] Seyedian, A., Esfandiari Kenari, M., 2013, "Two Shells Façade, a Step Towards Sustainable Architecture, Performance Evaluation", the two shells façade in humid temperate climate, the National Conference on Sustainable Architecture and Urban Development, Bukan
[21] Seyedian, A., Ibrahimi, A., Soleimani Majd, Shahedeh 2013, "Application of Smart Materials in Future Architecture, a Step towards Sustainable Architecture"
[22] Wigginton , Michael , Harris , Jude , (2002) , "Intelligent Skins" , First Published 2002T. London , Architectural Press,
[23] www.infolink.com.au
[24] http://c-s-p.ir
[25] www.vergolansw.com.au
[26] www.nanovation.com