# THE ROLE OF NANO TECHNOLOGY MATERIALS IN KEEPING THE ARCHITECTURAL HERITAGE

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**Abstract** - Buildings with Architectural Heritage are considered an important part of cultural heritage for any country that is why the two researchers reaching to some recommendations, Conclusions and additions, where the most important recommendation is the using of Nano Technology Materials because of their unique characteristics. Nano Technology Materials are Materials with high quality, did not need cyclic maintenance, and considered as Environmental friendly materials if they are compared with the ordinary materials used in Restoration process. One of the most treating new method that effect on the Heritage buildings in Restoration process is adding (SiO2) material which is treated with Nano Technology Technique on paintings materials which earn it a new property which is Self Cleaning. And in using (Zycosll) material which is treated with Nano Technology Technique on plaster materials it fills spaces and cracks in walls which make walls more strong. Also adding Nano silver substance (10-15 Nano meter) on painting materials it treated with Corrosions in heritage building caused by bacteria and fungi, so the two researchers recommended showing the research to responsible to keep the Architectural Heritage.

**Keywords** - Architectural Heritage – Architectural keeping – Nano Technology – New Materials – Self-Cleaning.

## I. INTRODUCTION

Communities pass with many civilizations through ages which produce buildings that describe each period of time , Architecture is the mirror of different communities As historical and heritage buildings with value represent an important part in our cultural heritage for each country which make interested people seek for keeping these buildings As they contain unique Architectural values and can be saved by using new materials that processing by Nano technology which helps in reducing maintenance costs and gives high quality if compared by traditional materials that affected by the climatic factors rapidly , react with bacteria and fungi , need cyclic maintenance in addition to their low quality.

### A. Research problem

The Traditional Materials which are used in Restoration and Maintenance processes are not suitable for using with Heritage Buildings that is because of their short life time and their bad quality , which requires making regular maintenance for this building ,while using Nano Technology Materials Save the identity of these buildings as Nano Materials have long life time and high quality.

### B. The Importance of Research

The Importance of the Research Comes from two main points, first the National Trend which calls for keeping the Architectural Heritage. Second the study of materials which proves that using ordinary materials lead to making cyclic maintenance from time to time due to their low quality which cost a lot and increase the building budget while, in the opposite side Nano technology materials have high quality and need simple maintenance, So from here the idea of the research begins .

### C. The Research Goal

The Main goal of the research is represented in the effect of using Nano technology applications on the materials which is used in restoration process and their important on keeping heritage buildings and that can be reached through some secondary goals as shown:

1- Identify the meaning of Architectural Heritage.
2- Identify new methods on keeping heritage buildings Such as Nano Technology applications.

### D. The Research Methodology

The study included two parts the first part is The Theoretical part which consists of the identification of Heritage Buildings, the identification of Nano technology Term with its metrics, and methods of reaching Nano measuring. While The Second part is the suggested practicalImplementation parton heritage buildings and the effect of using Nano technology Materials on them which Observes some examples that show the using of this Techniques on heritage buildings reaching to some Recommendations and Conclusions.

## II. IMPORTANT DEFINITIONS

### A. Architectural Heritage

It is all what have been constructed by Grandparents, where buildings can be differentiated according to their historic eras that belong to also according to their Arts and their Materials[1].

### B. Old Building

They are the buildings that passed by many years through different eras and do not make its function these days in addition to Its inability in Keeping up with the functional changes so it Only represents the oldness [2].

**C. Historical Buildings**

They are the old buildings that have an Architectural value in addition to their role as a registration for the history and the culture of the past civilizations also its forbidden to change or destroy these kinds , so they need special treatment and they submit to many restrictions in dealing with them As follows.

**D. Recycle**

It is the recycling process for different manufactured materials[3]. To decrease the draining of natural resources.

**E. Nano Science**

It is the science that deals with the studding of Nano scale, by knowing its new properties, determining its chemical physical and mechanical characteristics and studding Phenomena Associated with decreasing of the size.

This science also aims to produce new category of materials knowing as Nano materials their unique properties fits with the Requirements of advanced technology applications for this century[6].

**F. Nano Scale unit**

Nano scale unit is ($1*10^{-9}$), so the Nanometer is one billionth of a meter, and the Nano second is the equivalent of one billionth of a second [6] as shown in figure (1).

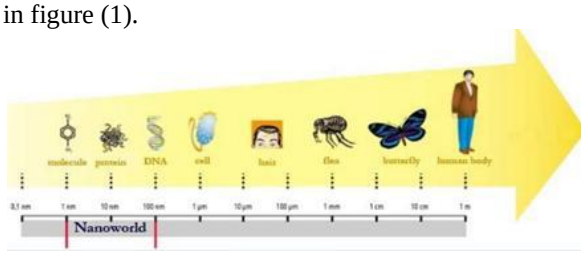



**Fig.1. The location of Nano scale unit according to human scale.**

## III. THE PRINCIPLES AND FEATURES OF NANOTECHNOLOGY

| Principle | Feature |
|---|---|
| The ability to control the movement of individual atoms and rearrange them. | The possibility of building any material in the universe because the atom is the building unit of all substances |
| Physical and chemical properties of a substance at the nanometer scale are different from the properties of the same substance at its natural scale. | Discovering unique properties of materials that are used in many inventions and practical fields |
| Nanotechnology is based on the principles of physics, chemistry, biology, electrical and electronic engineering sciences | Linking science and encouraging different scientific specializations to enter this field and cooperate with each other. |
| The ability of controlling the atoms in making materials, purifying them from impurities and clearing them from defects. | The properties of materials and become better, smaller, lighter, stronger, faster, cheaper and less energy consuming. |
| Nanotechnology is based on scientific researches that can be applied in useful inventions and uses. | Science fiction turned into real. |

**As shown in the following table 1.**

## IV. METHODS OF REACHING NANO SCALE SIZE

The most famous ways to manufacturing Nano materials are as shown in the fig. 2. (top-down and Bottom-up**)**.

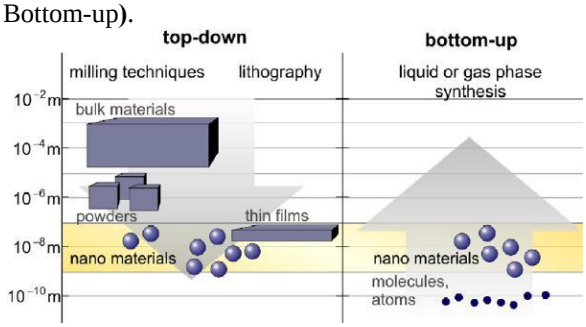



**Fig.2. explaining the different between the two methods for reaching to Nano scale.**

## V. THE IMPORTANCE OF USING NANO TECHNOLOGY MATERIALS ON HERITAGE BUILDINGS FROM THE VIEW OF THE RESEARCHERS:

The importance of using Nano Technology materials is the preservation of our heritage buildings which can be reused to reduce the depletion of nature's wealth and resources, also keeping these buildings has become a message Call out.

by current generations, as it is the best way to deal with these buildings from the civilizational, cultural and economic side, also The concept of conservation and keeping has been developed to be the re-employment of these buildings to be used again, so methods of dealing with these old historical and heritage buildings are no longer luxury, nor just keeping

The reuse of these buildings is the best way to preserve the architectural heritage in order to get benefit from it and achieve the development of our society, so reusing the heritage building from the researchers view achieves the following:

1- Finding a financial return to spend on the periodical maintenance of these kinds of buildings.
2- Prevent neglecting of heritage buildings.
3- Connecting the past with the present by opening heritage buildings to public for general uses which is suitable for these buildings.
4- Participating in developing the society economically and culturally
5- Reviving heritage buildings continue their life and their role in society.
6- Ensuring continuity of maintenance process for heritage buildings.
7- Trying to prevent the visual pollution of urban areas by developing the architectural artistic sense for citizens and passers-by[7].

But is it possible to continue keeping these heritage buildings and pay very high costs for traditional materials and for periodic maintenance operations, while using materials treated with nanotechnology are the best the initial cost (the cost of buying and supplying) for materials treated with nanotechnology may be greater than if it compared to traditional materials but they are the best in the quality factor as well as economically in the actual cost as, they do not need Except simple maintenance, unlike traditional materials which cost a lot over time, that will be explained according to the following formula:

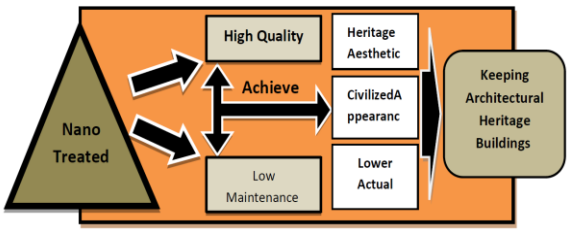



**Fig.3. explaining how to keep Architectural heritage buildings by using Nano treated materials**

There will be listed some examples of heritage buildings that were damaged through using of traditional materials in restoration and maintenance processes which also resulted in damaging some valuable architectural elements that impact the aesthetic and civilizational appearance in shape and external color as shown in figure (4,5,6), so it is recommended to use materials treated with nanotechnology.



Fig-1:Beshara heritage building–Egypt – Asuite



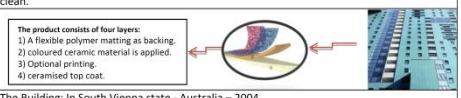
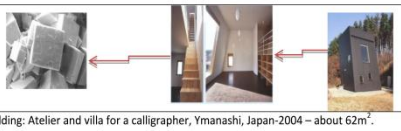
Fig-2:Historical villa – Egypt – Alexandria



Fig-3:AlQuba Mohamed Ali Palace –Egypt – Swiss

| | Reasons of Using Nano Treated materials from the View of the researchers |
|---|---|
| 1 | Nano treated materials are economically better because they are less in the actual cost over time. |
| 2 | Nano-treated materials work as thermal insulation materials. |
| 3 | Nano-treated materials work as sound insulator materials. |
| 4 | Nano-treated materials are self-cleaning materials that do not need periodical cleaning and maintenance. |
| 5 | Nano treatment materials can reflect harmful UV rays. |
| 6 | Nano treated Materials Withstand bad weather conditions. |
| 7 | Nano Treated Materials are classified as environmentally friendly materials |

## VI. APPLICATIONS OF NANO MATERIALS ON KEEPING HERITAGE BUILDINGS

| | |
|---|---|
| **A. Nano-treated painting with silver Nanoparticles:** | |
| **Nano Used Material** | **Nano-treated painting with adding silver nanoparticles (10-15 nm) is a substance for treating erosion in heritage buildings caused by bacteria and fungi.** |
| **Example** |  |
| | Deutsche Annington Immobilien-Germany in (2004)The Building :<br>The Architect: Joachim Osterland,Essen<br>It is possible to manufacture surfaces to be germicidal and antibacterial due to Silver Nano particles. Whether in materials or in the form of invisible coatings to which the Particles have been added, this building was treated in 2004 and remained the same till now[8]. |
| **B. Nano Anti- graffiti drawings Painting:** | |
| **Nano Used Material** | **Nano Anti-graffiti treated painting is a painting to protect Heritage buildings from drawings and writing on the facades.** |
| **Example** |  |
| | Homager Palais Berlin, GermanyThe Building :<br>The Architect: Hilmer,Sattler and Albrecht[7]<br>Now heritage facades can be saved from drawings and writings to keep them with their original form. |
| **C. Nano Anti- dust Ceramic tiles(Green Ceramic):** | |
| **Nano Used Material** | Using (ETC) Nano treated ceramic Tiles with four polymer layers to make surfaces easy to clean. |
| **Example** |  |
| | The Building: In South Vienna state - Australia – 2004.<br>High about (77m) from Green Ceramic tiles and contain (182 apartments).<br>The Architect: Albert Wimmer, AN-architects<br>Using (ETC) Nano treated ceramic Tiles with four polymer layers to make surfaces easy to clean and protect heritage facades from continues accumulation of dust problem[8]. |
| **D. Nano treated plaster with Zycosll :** | |
| **Nano Used Material** | White treated plaster with Zycosll material that fill cracks and spaces in heritage walls also it is Self Cleaning material[8]. |
| **Example** |  |
| | The Building: Private residence, Agstall, Germany about 300m$^2$-2000<br>The Architect: Hild and K Architekten.Andreas Hild.Dionys Ottl. |
| **E. Nano Wooden Boards:** | |
| **Nano Used Material** | **Nano Wooden Boardsare called purifying building board** |
| **Example** |  |
| | The Building: Atelier and villa for a calligrapher, Ymanashi, Japan-2004 – about 62m$^2$.<br>The Architect: Kazuyasu Kochi. |
| **F. Nano-treated painting with (SiO2) Nanoparticles:** | |
| **Nano Used Material** | A treating material for heritage buildings that are located near water sources (rivers or seas) it is formed from Nano-treated painting with ($SiO_2$) Nanoparticles that protect surfaces and facades from corrosion and Humidity, Also it is Self Cleaning Material. |
| **Example** |  |
| | The Building: Strcksbarg Housing, It is located in the coastal city of Hamburg, [9] Germany.Facades are about (3686m$^2$).<br>The Architect: Renner Hinke with Aarten. |

## VII. CONCLUSION

1- The architectural heritage is considered a mirror that reflects the culture of different societies, but it is relatively deteriorated due to the traditional materials used in restoration and maintenance operations.
1- There are a lot of methods of preserving the architectural heritage buildings, but the best of them is the materials treated with Nanotechnology which used in maintenance and restoration operation.
2- The materials treated with nanotechnology are the best in terms of longer life time and higher quality.
3- The use of Nanotechnology materials in restoration operations is the best, even if the purchase cost is high, but the actual cost is low, especially as it does not consume expect very simple maintenance costs.
4- Nanotechnology treated materials are environmentally and friendly materials compared to the traditional materials used in restoration processes.
5- One of the most important results that the two researchers recommended is that using of Nano treated materials such as NanoSiO2, Nano Zycosll, silver Nano, and treated Nano Ceramic tiles are the best in making restorationprocesses for heritage buildings that save their historic feature and keep them from extinction.

## RECOMMENDATIONS

1- The importance of keeping historical buildings , protecting them from deterioration, and making cyclic restoration for them as they are witnesses of an important period of time in societies life .
2- Presenting the research to the Competent authorities to take what is appropriate regarding these proposals, especially those imposed by the researchers and using these new technology rapidly on heritage buildings
3- The importance of recommending Nano treated materials from all competent authorities to obtain better quality and less cost for long-time restoration and maintenance processes.
4- Presenting the research to the competent authorities to take what is appropriate regarding these proposals, especially those imposed by the researchers and using this new technology rapidly on heritage buildings.
5- The researchers believe that the phenomenon of neglecting heritage buildings should be reduced by stop using traditional materials that can lead to losing the Identity and the Heritage.
6- The research can be presented to the relevant ministries, such as the Ministry of Culture, Ministry of monuments and Ministry of Housing, for activating.

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