

Explaining the Role of Material in Vernacular Architecture and its Comparison with Modern Materials Architecture and Utilizing Nanotechnology

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Abstract—Generally the first thing which comes to mind about traditional and old monuments is their local material. The way of using the local materials, and corresponding with region and climate where the building is constructed is of paramount importance, but nowadays due to the developments in architectural knowledge, vernacular architecture all over the world that were inspired of the nature and the environment has been forgotten and mostly modern materials, which they have no relevance with climate, are used. Nowadays, more than ever, architecture profession is faced with a vast range of materials and substances. Nanotechnology makes the monitoring of intrinsic features feasible by developing some structures in nanometer scale. This means that, fewer materials with better quality are required for a determined function. In this article, Library method to investigate the issues has been chosen, and its results show that modern construction of the local materials was more effective than modern materials in raising the level of life safety considering the physical, mental, and economical aspects and consequently will lead to healthy individual, healthy family and healthy community.

Keywords—Material; Modern Architecture; Vernacular Architecture.

I. INTRODUCTION

SUFFICIENCY as a maximum use of available facilities and local materials was an old method of constructing a building. If this method can be adjusted with our country's engineering and technical requirements, one of the most fundamental measures of providing dwelling for low-paid people will be taken. Almost everywhere, nature has provided materials for construction. As these materials need less processing or shipping, economical and environmental costs are low. Some resources like (trees and straw) are renewable; some are so abundant that count as endless resources like (stone and sand). On the other hand since stone, clay, brick and wood give the building native identity or belonging to the place, it is pleasant and desirable [Khoda Bande et al., 1378]. Providing the cheap dwelling is one the basic problems of burghers, so designers and architects have effective roles in lowering the building costs. This is due to the fact that they can move toward sustainable urban

development by rendering the appropriate approaches in the field of construction using local and traditional materials considering the principles of expenditures reduction [Bashiri Mahsa, 1391]. Comparing the spaces of old and new houses clarifies the importance of traditional and new architecture and consequently the effects of technology, so that by studying and investigating some samples of old house architecture and analyzing the interior and introspective spaces of traditional houses, the role of material becomes clear in sustainable housing development considering climatic factors which are effective on sustainable housing designs. Using local technology and materials, technology in current vernacular houses and modular design by prefabricated materials as well as considering the sustainability principles to achieve cheap houses would be efficient. In this article it is attempted to study the features of traditional architecture considering durability, and positive and adaptable points of current life method, and utilizing the advantages of technology in designing, an opportunity is

provided following the mentioned process and in its adjustment and combination with present conditions to take further steps toward sustainable development.

II. FAMILIARITY WITH LOCAL AND TRADITIONAL MATERIALS

2.1. Local Materials and Location

Using local materials is possible in different areas since these materials don't need to be prepared or shipped to the location, have minimum economical and environmental harms, and considerably some of the applied natural resources like, tree, cane, etc. are restorable and renewable and some others like sand and gravel are highly accessible. Also it can be referred to some other local materials such as stone, adobe, thatch, etc [Khorshidi Najmeh & Ghafari Ali, 1391].

2.2. Natural Materials

One of the main important reasons of using the natural materials, except industrial reasons, is that in this method manufacturing contamination is minimized. In manufacturing one ton of Portland concrete, exactly the same amount of carbon-dioxide emits into the air. Another reason is consistent with human beings health. Natural materials less jeopardize human beings health. The quality of inner air is a very important factor [Khorshidi Najmeh & Ghafari Ali, 1391].

One way to accelerate the air exchange without decreasing the heating function at home is to create a breathing case. This can be done easily by some materials like thatch walls or wooden structures. It is healthier and more beautiful for structures to be built by natural primary materials. Stone, glass, lime, plaster, soil, adobe, brick, tile, unprocessed wood, cork, paper, bamboo, cane, natural plants and fibers (linen, cotton, wool...) are the natural materials that are applicable in construction [Khorshidi Najmeh & Ghafari Ali, 1391].

2.3. Recycling Materials

Materials must be used to their maximum, unless more materials should be manufactured. Materials should be used in a way that there would be no need to transfer them to the Landfills or to prevent further operations on them. All kinds of materials can be used at home. For instance the combination of paper and concrete can be used to coat the walls [Khorshidi Najmeh & Ghafari Ali, 1391].

III. EFFECTIVE CLIMATIC FACTORS ON TRADITIONAL CONSTRUCTION

Some effective climatic factors on traditional method of construction include: interaction with nature, designing with less need to energy resources, exploitation of renewable energy resources like wind and sun, low use of water, and gathering precipitation [Ahmadian Chashmi Hoorieh & Hashem Nejad Hashem, 1391].

There are many ways to produce clean energy like solar, wind, water and etc to make electricity and use the fossil fuels economically. In the case of using these clean energies to produce electricity, this electricity should be applied with great care because it is so limited [Khorshidi Najmeh & Ghafari Ali, 1391]. Regarding the restricted amount of fossil resources and the pollution due to the use of these resources, thinker societies try to use renewable energies instead of fossil resources. Nowadays, sometimes due to design weaknesses, a remarkable percentage of primary energies are used for heating, cooling and lighting in buildings. With paying slight attention to designing principles adjusted to climate and using renewable energies, energy consumption can be reduced in buildings remarkably [Zahra Ghiabgaloo, 1389]. The ancients acquired broad information about architecture potentials and were able to modify radiant heat and sun shade. In fact, using the sun as a heating resource is not a new thing. 2400 years ago, Socrates found out that in houses that face south, the sunlight enters the porch in winters, but in the summer sun mostly is on top of the roof in a way that makes a shadow. Therefore, the southern side should be built bigger and more elongated to absorb sunlight and the northern side should be built shorter to avoid winter winds.

Such a house can be a good place in all seasons [Zahra Ghiabgaloo, 1389].

In some climates, ventilation is considered as one of the most important objectives in designing. This kind of designing is applicable in desert houses of Yazd through solar chimney.

Based on four seasonal climates, buildings are designed adjusted to environmental conditions and their climate. Thus, in different climates some various factors like wind, sunshine, temperature and humidity play important roles [Kasmaee Morteza, 1382].

IV. IRAN'S CLIMATIC CLASSIFICATION

| Climatic Zone | Weather Features | General Features of Traditional Building |
|-----------------------------------|---|---|
| Southern shore of the Caspian sea | 1)high rainfall in all seasons 2)relatively high humidity in all seasons 3)little temperature difference between day and night 4)broad flora | 1)inclined roof 2)patio around the building 3)extroverted form of building 4)lack of basement 5)the floor of ground higher than the normal surface of the earth 6)two-side ventilation |

| | | |
|---|---|--|
| Northern shore of Persian Gulf and Gulf of Oman | <ol style="list-style-type: none"> 1)low annual rainfall 2)high humidity in all seasons 3)very hot and humid weather in summer and moderate in winter 4)little temperature difference between day and night 5)salty ground waters in most places 6)very low amount of flora | <ol style="list-style-type: none"> 1)buildings with central courtyard and semi-introverted 2) Maximum use of shadow and draught 3)high rooms and long windows 4)broad and high porches 5)lack of basement 6)mostly flat roofs |
| Mountainous and high places of plateau | <ol style="list-style-type: none"> 1)severe cold in winter, moderate in summer 2)heavy snow in north and northwest of the country 3)low humidity 4)high temperature difference between day and night | <ol style="list-style-type: none"> 1)building with central courtyard and in introverted form 2)low ratio of the outer crust to the building's size 3)low height rooms 4)flat roofs 5)small openings 6)small patios and yards 7)relatively thick walls |
| Plateau plains | <ol style="list-style-type: none"> 1)warm and dry weather in summer, cold and dry in winter 2)low rainfall 3)low humidity 4)low flora 5) high temperature difference between day and night 6)deserts and around deserts windy and dusty | <ol style="list-style-type: none"> 1)all buildings are surrounded and introverted 2)all building with central courtyard and most of them with basement, porch and air trap 3)building floor and specially yard lower than streets 4)high rooms 5)vaults and domes 6)relatively thick walls |

(vahidGhobadian, climatic study of traditional buildings in Iran)

V. COMPARISON BETWEEN SPACE DIVISIONS IN OLD AND NEW BUILDINGS

| Space Divisions of Old Buildings | Space Definition | Space Divisions of New Buildings | Space Definition |
|----------------------------------|--|----------------------------------|---|
| Entrance | In most old buildings, doors are double match and wooden and each match has a knocker. The knocker which had treble sound was for women and the one with more bass sound was for men that had a hammer shape. | Bed room | In each house a room is allocated to parents and another one to children |
| Vestibule | Often like an octagon or semi-octagon or in most occasions in a quadrangular shape. Vestibule with low ceiling | Living room | A place to watch TV |
| Corridor | A narrow corridor which showed the way of vestibule to the yard to guests with some meanders. The meanders were used to protect the privacy of the owner so that the guests can not immediately learn about things that were done in the yard. | Dining room | In new houses, kitchen, living room and dining room are combined |
| Yard | Yard in old buildings was in the center of the house and was considered as the heart of the building. Central yard with porches in all sides was a feature of Iranian architecture in old buildings | yard | Nowadays, most buildings due to their shape in an apartment form and increase of land cost don't have any yards |
| Kitchen | Usually in square or rectangle shape, near well or cistern. There was a place for cooking, storing wood and an oven to bake bread inside the kitchen and a niche was improvised in the wall for putting kitchen tools and food | Kitchen | Kitchen and living room were combined and the kitchen is not in the corner of the yard |
| bathrooms | Usually are placed in lower places in comparison with the normal surface. This was due to ease of using water and drainage and its warmth. Bathroom is divided into two parts of locker room to change clothes (Sarbineh) and another one for washing and showering (bath) | Bathrooms | Bathroom and toilet are combined and are placed inside the building |

| | | | |
|-------------|--|------------------------|--|
| Winter stay | The main space of winter stay was placed on the basic axis and the windows were made of big sashes to absorb more sunlight | Pilot and garage | Usually in apartments the ground is called pilot and is usually used as garage |
| Summer stay | Has a location like summer stay. The only difference is that it is placed on the southern part of the yard so that protect the house from direct sunlight and on its main axis there is a semi-open space or hall. | Staircase and elevator | These are places that allow accessing to different floors |
| Terrace | This is a space with no roof which is placed next to the yard and in upstairs. In the summer it was used for sleeping and based on its location it was used at the hours that the shadow of walls fell over it. | Storage | In new houses, due to their small space and lack of basement a place is allocated to store food and etc. |

(Mehraz, 1389)

Nanotechnology and Stable Materials

Nanotechnology creates the possibility of monitoring the intrinsic traits such as melting temperature, magnetic properties, load capacity and even the color of materials without a change in their chemical composition by developing some structures in nanometer scale. This means that, fewer materials with better quality are required for a determined function. Thus, the needed energy for providing these materials is reduced tangibly. Most of the features of a material like paint, durability and fragility are controlled. The possibility of preparing desirable materials with the considered traits in different sectors of construction and their related cooling and heating installations is provided; given our requirements and desires, this technology plays an outstanding part both directly and indirectly in reducing energy consumption [www.nanotechnology.blogfa.com].

VI. THE APPLIED SCOPES OF NANOTECHNOLOGY IN CONSTRUCTION INDUSTRY

Utilizing the nanotechnology in architecture includes a wide range from the first stages of designing and simple blueprints to the final stages and tangibility of the joineries. This application can be easily found in choosing proper materials, thus, not only it reflects the designing ideas and imaginations, but also it has a profound effect on the way of thinking and reflection of the architecture. The diversity of decision making along with a vast range of options provides designers with nanotechnology. The following briefly demonstrates some eras which improve the conditions of construction industry:

- Optimizing the available materials
- Preventing the damages
- Reducing the weight and volume of constructing materials and elements
- Reducing the number of developing stages
- Utilizing the materials in a more efficient way
- Lowering the need for maintenance and its expenses [Atieh Dezfouli, 1390]

VII. LOCAL MATERIALS USED IN DIFFERENT CLIMATES OF IRAN

7.1. Wood

In warm and humid areas, it is better to use the materials that have less thermal mass and don't store heat in themselves. Climatically, the basic problem is the extreme heat and it is not a right thing to store the warmth of day for night. Due to this fact wood is the best material in these areas since it transfers heat slowly and the absorbed heat during the day remains on the surface of wood and during the night with a relatively cool breeze it loses its heat [Viseh Sohrab et al., 1388].



Figure 1: Using Wood in Warm and Humid Areas

7.2. Soil

Soil, on one hand, is considered as a material in construction by the designers and engineers and on the other hand is utilized as a natural environment by human being.

Using soil as a material (optional application) for making an embankment in the back of retaining wall, drainages, paving the roads and airports and also as the main substance of making mortar, brick, ceramic, china, fireproofs, concrete and etc. using soil as an environment and bank (obligatory application): for the infrastructures and the bank that a house is build on it, road substructures, bridge substructure, the location of pipes and mechanical and electrical facilities and etc [Zomar Shidi Hossin, 1377].

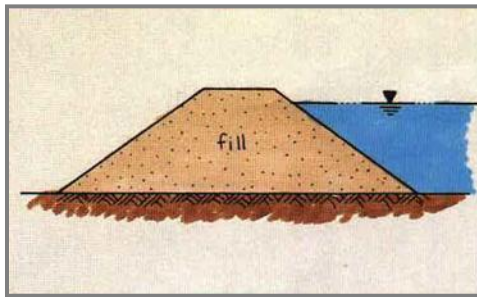


Figure 2: Making Embankment



Figure 3: Soil as Substructure

7.3. Adobe

Using adobe has the following advantages: doesn't pollute ecosystem, is inexpensive, stores thermal mass, has the optimal heating transfer features for heating in the summer and cooling in the winter. Since soil is a suitable substance for construction and is available all around the world and regarding the fact that soil materials need the least amount of processing, production can be local and decentralized and construction can be done by a self-assistance method to reduce expenses. Adobe production only needs 1 percent of the energy required for producing brick and Portland cement. Construction by using adobe generally needs manpower, thus it helps domestic economy, reduces sound transmission, it is not toxic and also soil acts better in humidity balance in comparison with other traditional materials [Viseh Sohrab et al., 1388].



Figure 4: Using Adobe in Building

7.4. Clay -Wall

Clay-wall is possibly the oldest and simplest solid building system.

A clay-wall building may have a long life by providing proper roof, infrastructure and coil and also protecting the building with external coating if necessary. High thermal

mass and insulation combination makes it ready to be used in proper passive solar constructions. Since clay-wall doesn't have the mortar chinks visible in adobe and brick walls, it's more resistant against earthquake. Clay-wall is totally informal and recyclable. It is independent of production and mechanization and has extremely low environmental expense; its economical expense is low similarly. Clay-walls, indeed, are able to absorb large amount of water without getting damaged, but only if they get dried [Smith Michael, 2005].

7.5. Brick

The followings can be helpful in identifying the desirable brick:

- A desirable brick is the one that has regular and complete geometric shape.
- The color of brick should be uniform; it also shows uniformity of its chemical material and baking it.
- The brick texture should be congruent and without any chinks. It should be hard in a way that cannot get scratched by nail.
- A desirable brick should ring in hitting with another brick which shows its high quality, resistance solidity and its less water absorption.
- If whitish stains appear on the surface of brick after 24 hours staying in the water, it can be understood that it contains excessive amount of minerals, salt and lime [Hamiahmad, 1376].

Employment, capital expenditures and currency saving, reduction of brick production costs and industrialization are considered as the economical-social aspects of brick production. Thermal conductivity of brick depends to its glass and crystal ratios and its porosity. Thermal conductivity increases by the elevation of humidity. Due to the fact that brick is a baked material, its function under fire conditions is generally perfect [Viseh Sohrab et al., 1388].

7.6. Cane

On the coasts of Persian Gulf and the Gulf of Oman, poor people live in the areas that canes grow and next to palm-groves in matted houses named shed. Completely grown canes besides river-basins and/or palm leaves are used to build sheds. Its skeleton is made of long canes or/and middle branches of palm leaves which are knotted to each other and their thickness is about 10-15cm.

VIII. NEW AND COMMON MATERIAL USED IN CONTEMPORARY BUILDINGS

8.1. Steel

Steel term is used for that iron alloy that contains %25 to 2 percent of carbon. Alloy steels often are accompanied with other metals. Steel traits depend on the percentage of carbon in it, conducted heating operations and alloy provider metals in it. Usually the internal wall of furnace used to produce steel is covered by bricks made of materials that help melting.

This cover absorbs some of the emitted oxides. Usually in order to separate impurities open furnace method is applied. This furnace consists of a plate-like container which can take 100-200 tones of melted iron. On top of this container, a concave roof is placed to reflect heat to the surface of melted iron. An intensive flow of oxygen is passed over the melted metal to burn its impurities. In this method, due to heat transmission in the liquid and scattering, all the impurities come to the surface of the liquid and this refinement takes a couple of hours. Some of the iron is oxidized which is again gathered and transferred to the high furnace [www.imencms.com].

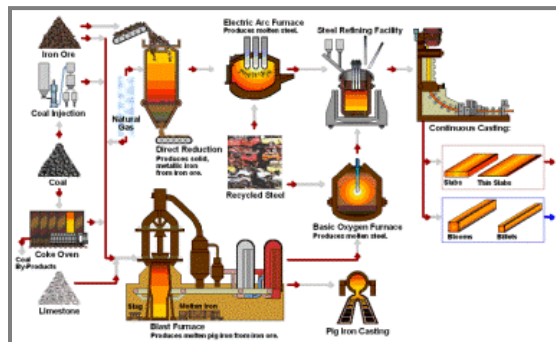


Figure 5: Method of Producing Steel

8.2. Concrete

Concrete is produced through the combination of water and cement and the reaction between them. Concrete along with steel is one of the most widely used construction and development materials which is utilized in building dams, bridges, houses, roads, streets and etc. nowadays, concrete and steel are extremely used in construction and development workshops. Concrete and steel structure are designed and built based on the type of application. The components of concrete are: cement (about 7-15%), water (about 14-21%), and rock grains (about 60-75%) [www.wikipy.com].



Figure 6: Concrete Preparation

8.3. Composite

Using new materials and specially composites instead of steel in last decade was very popular all around the world.

Composites were made of sticky material (mostly Appoxi) and appropriate amount of fibers. These fibers can be made of carbon, glass, Aramid, etc. and the obtained composites respectively are called CFRP, GFRP, and AFRP. The main advantage of composites is their resistance against corrosion. Due to this fact, applying FRP composites in ferroconcrete instead of steel rebar is highly considerable. The main advantage of rebar made of FRP is its resistance against corrosion, nonetheless, other properties of FRP composites such as high tensile strength (up to 7 times more than steel), acceptable elasticity module, low weight and desirable resistance against corrosion and creep, magnetic waves insulation and high stickiness with concrete provide a desirable set of properties which make the application of FRP in ferroconcrete very appealing. However, some problems like matters related to bending them and also their absolutely linear trait up to break point make some application problems which nowadays are the subject of extensive researches as a proper substitute for steel instead of Ferroconcrete especially in coastal and marine structures [merzadcivilengineer.blogfa.com].

8.4. Polycarbonate Sheet

This product which is manufactured in many types of single and multi-walled and in many different colors has many traits which make it an appropriate option instead of glass in skylights. Light weight of polycarbonate sheet that is less than half of glass weight in an equal thickness, high resistance against break between 100 to 250 times of that of glass and resistance against ultra violet ray (UV), which is the main factor of skin cancer and the cause of pale furniture and skylight, puts the polycarbonate sheet among resistant materials against earthquake. Different types of multi-walled polycarbonate, remarkably help optimizing the fuel consumption and also the resistant layer against polycarbonate UV ray protects it for a long time from paling and destruction [www.hamshahronline.ir/details/172552].

8.5. Glass

Glass is one of the most useful materials in building which not only makes the building bright, but also provides a visual communication without door.

However because of a low insulation property, it is problematic in hot and cold seasons, and that's the reason why in past and present many different equipments like, sunshades, and curtains in summer were used to prevent entering extreme heat and light and in winter some equipments like thick curtains were used to prevent wasting the heat and energy inside the building [www.ifco.ir].

8.6. Nano-powders

These materials are made of the compositions of paints and substances with high density and applicable in eliminating radiations in construction, some of the applications include making high-potential explosives, paints, and polishes, polymers and biopolymers, chemical mediators, glues,

superconductors and etc [Avideh Talayi & Darya Nosrat Pour, 1390].

8.7. Carbon Nanotubes

A carbon nanotubes is created through rolling a one-atom-thick graphical sheet. This substance is 100 times stronger and 10 times lighter. This tube is also electricity conductor and fire resistant and has high durability and flexibility; meanwhile, they can be transparent and crystalline. However, the most astonishing feature of these substances is that, they can be designed and produced from the beginning based on the consumers’ application and requirement [Avideh Talayi & Darya Nosrat Pour, 1390].

8.8. Cement and Concrete

Utilizing the particles in nano scale results in improving mechanical traits and increasing the quality of concrete. For example, “nano- Silic improves the particle density and enhances concrete durability and etc. using titanium dioxide causes self-cleaning and disinfectant ability in concrete and gives whiteness and brightness to it” [Jan Bozorgi & Ghannad, 1389]. “Nano- aluminum is also a production that increases the compressive strength of concrete to some extent and greater structural strength against incoming loads elevates structural durability. Nano-titanium also prevents chloride permeability in concrete and degradation and corrosion of reinforcement and enhances structural lifetime” [Mahnaz Mahmoudi & Seiede Hadiseh Sadighziabari, 1387].

8.9. Nano-Coatings

These compositions can prevent the growth of bacteria and fungi and other pathogens; using these compositions in materials and glaze of tiles and ceramics and utilizing them in public places like hospitals avoids the spreads of pathogenic bacteria. “ the most outstanding advantages of applying Nano- coatings include providing desirable insulator coating, preventing the penetration of corrosion factors into these coatings, elevating resistance against heat transfer, corrosion,

abrasion and decay and higher self-cleaning feature of these surfaces” [Jan Bozorgi & Ghannad, 1389].

8.10. Nano-Glass

Among Nano-technology applications related to glass productions, we can refer to energy-controlling glass which is disinfectant and stainless. Energy-controlling glass results in less ultraviolet and infrared radiation transmission, regulation of visible light transmission and prevention of energy waste in building [Mahnaz Mahmoudi & Seiede Hadiseh Sadighziabari, 1387]. Fire resistant glass is another application of Nano technology [Mohammad Pour Jafari & Mohammad Asadi, 1386].

8.11. Self-Cleaning Paints

Producing self-cleaning and scratch-resistant glass by nano structure is another usage of Nano technology in construction industry. These paints are nano-metric patterns and structure that can be cleaned by sunshine or rain and without any cost [Shabnam Tannazian & Hasan Sattarisarban Gholi, 1392].

8.12. Photovoltaic Cells

However, high cost of producing them, emission of toxic gases in manufacturing process, high volatility of generative voltage by light change and reduction of cell efficiency through a change in light angle are some of the factors that make people not to welcome these productions in our country. While, development of Nano technology and simulation of photosynthesis process in plants has led in creation of a new generation of cheap, but highly efficient photovoltaic [Mohammad Haghshenas, 1387].

8.13. Nano-Filters

In addition to recycling some elements like salt and calcium, Nano filters are able to recycle their viruses and bacteria. Therefore they can be used in water treatment systems and ventilation systems in constructions. The active Nano particles analyze any kind of contamination and transform them to safe materials [Mohammad Haghshenas, 1387].

IX. COMPARING MATERIALS USED IN OLD AND NEW BUILDINGS

| Old Materials | | |
|---------------|---|---|
| Material | Pros | Cons |
| Wood | 1)heating and cooling insulation 2)fairly well mechanical resistance and elastic property in stroke 3)surface polishing capacity, tonality, craving and cutting 4-possibility of property modifying (fire proof, water proof, antifungal materials). | Pests, process lacking, damager, and diseases lead wood not to be categorized based on its physical and resistance features. Wood sample cannot often be found among different types. Cracks, middle part weakness, and branch twist produces tension in the trunk. |
| Soil | Soil, on one hand, is considered as a material in construction by the designers and engineers and on the other hand is utilized as a natural environment by human being. | 1)armature and molding in these structures requires expertise and spending more time rather than other structures 2) due to increasing number of segments in these structures they are heavier than other metal structures |

| | | |
|------------------|---|---|
| adobe | Using adobe has the following advantages: doesn't pollute ecosystem, is inexpensive, stores thermal mass, has the optimal heating transfer features for heating in the summer and cooling in the winter | Generally, adobe has 2 disadvantages, it doesn't remain solid in water and it cracks after drying |
| Clay-wall | A clay-wall building may have a long life by providing proper roof, infrastructure and coil and also protecting the building with external coating if necessary. High thermal mass and insulation combination makes it ready to be used in proper passive solar constructions | The problem of using muddy clay-walls in rooms is that they are not vertical and flat which doesn't have that much beauty. Another problem is their heaviness which makes them non-resistant against earthquake |
| brick | Thermal conductivity of brick depends to its glass and crystal ratios and its porosity. Thermal conductivity increases by the elevation of humidity. | Complexity and deformation, cracking, boiling half baking, darkening hollowness and Efflorescence's |

| New Materials | | |
|----------------------------|---|--|
| Material | Pros | Cons |
| Steel | High resistance, elastic properties, formation, cohesion, retrofitting, light weight | Weakness in high temperature, corrosion and metal decay against external factors, tendency of compressed parts to buckle, inappropriate building |
| Concrete | 1) due to ductility possibility of new concrete, mold and armature, they are applicable in different areas 2) these structures are fire proof | _____ |
| Composite | High ratio of strength to weight and stiffness to weight, non-corrosive and non-magnet, suitable energy absorption trait, long lifer capability of putting sensor in it to control its function | High price of crude materials and making procedure, low toughness, environmental contamination specially about polymer composites |
| Polycarbonate Sheet | Light weight of polycarbonate foil that is less than half of glass weight in an equal thickness, high resistance against break between 100 to 250 times of glass and resistance against ultra violet ray (UV), which is the main factor of skin cancer and pale-furniture and sky light | Its most striking fault is the excessive heat under these sheets specially in warm months |
| Glass | Prevents wasting energy, provides beautiful vision and prevent extra noises | Chipping scratching bending and smoke stains |
| Nano Powders | Radiation elimination in buildings, vast range of usages in industries like producing high-potential explosives, paints and coatings, polymers and biopolymers, chemical mediators, glues, super conductors and so on, size distribution of control particles. | _____ |
| Carbon Nanotubes | Low thickness, extremely high resistance, low weight, transparency and clearness, designing based on consumers' requirement. | _____ |
| Cement and Concrete | Causes improvement of mechanical traits and increase in concrete quality, disinfection and self-cleaning features, greater structural resistance against incoming loads, reduction of ability to penetrate into concrete, prevention from destruction and corrosion of reinforcement. | _____ |
| Nano coatings | Prevents the growth of bacteria, fungi and other pathogens, avoids the penetration of corrosion factors into the coatings, increases resistance against heat, corrosion, abrasion and decay and elevates the self-cleaning feature of these surfaces. | _____ |
| Nano Glass | Self-cleaner, energy controller, stainless and disinfections fire resistant | _____ |

| | | |
|-----------------------------|--|--|
| Self-cleaning paints | Self-cleaning trait, without any cost, scratch-resistance and highly waterproof | — |
| Photovoltaic Cells | Clean and with no contamination (eliminating green house gases emission like carbon dioxide), eternal, free and available, reduction of fossil fuel consumption, safe and sound. | High cost of producing them, emitting toxic gases in their manufacturing process, sever volatility of generative voltage by a change in light, reduction of efficiency by changing the angle of light. |
| Nano Filters | Recycling some materials like calcium and salt, recycling water viruses and bacteria, analyzing different kinds of pollution. | — |

X. CONCLUSION

Investigating and comparing the past and present space division shows that the difference between our life and our ancestors' life, our architecture and their architecture, have affected the economy of energy resources and saving them. Our old buildings which were made of native and local materials acted as a sufficient structure in supplying energy and with the less use of fossil and irreversible fuels provided a convenient place for its residents. Traditional architecture before the technology development and new construction materials production was considered as a kind of architecture and identification in all parts of our country in any forms and any qualities which had its own unique technical methods and materials during lots of centuries. However, nowadays with the appearance of technology and use of fossil fuels and other natural resources in producing new materials, the natural life of human being is threatened. Therefore, it's necessary to search for new approaches instead of putting new materials industry aside. These Approaches can solve environmental problems and meet the needs of future generations for primary and crude natural resources. Development of nanotechnology provides new methods of constructing with lower costs and better quality and durability and also results in lower energy consumption. Undoubtedly, construction industry will utilize the numerous advantages of modern nanotechnology in the decades ahead.

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