An Analysis on the Manner of Designing the Conservatory with Spatial Transparency Approach

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Abstract

The transparency principle has been from the important principles of existence and it means the permanent movement and existence evolution from material quality to the spiritual quality. Iran's architecture transparency should be mainly chased in its spatial transparency and it can be said, architecture generally transverses the procedure of reaching to the transparency principle and reduction of material up to reach to the space. On the other hand, the contemporary history of our architecture has been always the arena of discussion about technology. Definitely, there has been no evasion from new technology and technology is the destiny of our days. But, the important issue is the manner of encounter and use of it. Therefore, creation of architecture committed to maintain the biosphere by utilization of new technology which also provides human comfort, can be helpful in this field. But, the fundamental issue which is intended in this research, is to consider one of the main approaches of Iranian architecture namely "spatial transparency". The research results indicate that in Iran's architecture, building has a language which has been originated from Iranian culture and the transparency principle in Iran's architecture and urbanism is the permanent and evolitional procedure of reduction of material and increase of space and on the other hand, transparent space is in the opposite point of closed space concept. Iranian architecture has been always in line with making the mass more transparent and lighter, creating the space and increasing the free space and spatial flux in its buildings and urban spaces. In the closed spaces of traditional architecture, a point or points have been always cognizable as the heart, path or paths of the spatial axes. These spatial axes conduct the person from the beginning of entering to the space. Therefore, this article seeks to study different aspects of the movement factor in reaching to the space in different elements of traditional elements. But, we always should commemorate that approaching to the response of these questions merely doesn’t depend on our demand in the place of questioner, rather, it is a message come out from this architecture. Comprehensive confrontment with these questions depends on constancy in questioning and needs the opening of this procedure as the way of thinking.

Key words: Conservatory, spatial transparency, spatial constancy, Iran's architecture

Expression of problem

It seems that the principles of transparency can be sought at the beginning of modernism and in the painting art from cubism to futurism, constructivism and the works of De Steel, Kandinsky, Moholy Nagi and Malevich that with such an approach to the theoretical origin and principles of transparency and of course, according to the analysis of the initial buildings of modern era, the concept of transparency in the building body and architecture can be divided into 8 groups; real transparency, one-sided transparency, two-sided transparency, transparency pages, two-dimensional apparition transparency, three-dimensional apparition transparency, transparency in meaning, combinative transparency which are significant in the materials, kind of manifested opening, passage domain, light control and of course, luminosity and they have more effect on transparency of western contemporary buildings (Babae and Soltanzadeh, 2011). The somatic subject that we have considered, fundamentally either in physical aspect or mental concept is a proper context for considering the subject ahead. Conservatory due to the sustainable-like nature and its relation with sustainability concepts is a subject which can be a proper context in proving a hypothesis which is
proposed later. On the other hand, in Mirmiran's opinion, Iranian architecture has had a share of history during numerous historical periods and today, this share is inconsiderable. Therefore, the fundamental issue which exists in line with this research, is to apply typology from architecture in which the spatial transparency approach can be indicated. In this line, the aim of the research is to apply the concept of transparency in the exhibition-conservatory spaces and the applicable and operational aims of it are to generate sustainable architecture paradigm in contemporary period as an unavoidable concept. Therefore, it can be expressed that the applicable aim of doing the research is to attain the concept of sustainability from the concept of "spatial transparency".

The research background

Transparency is one of the most important missed cases of contemporary human. This word doesn’t mean that before it, among different cultures, this attribute was ignored in architecture. The reality is this issue that before modern period and achieving new materials, a thing which has been considered from transparency, according to the architectural policies, has been for the lightness of volumes and in other words, architecture. But, in the contemporary period, new materials created the transparency covetousness with the meaning of being glass-like in the heart of architectures. Namely, the architect of new arena somehow even for proving himself by his former architectural tradition invaded toward this transparency. In the architecture, it has been assumed that the transparency forces us to understand different spaces simultaneously and causes to create different perceptions and feelings inside and outside of the space. The importance of this issue is mostly due to this case that by comparative study of attitudes and views about concept of transparency in contemporary era, the principles of formation of this concept and its kinds are explained with the aim of attaining a precise and structural objective definition of mental and theoretical concepts.

The theoretical principles

Transparency and its history

The lexical meaning of transparency expresses the physical quality of material and its practical meaning expresses the quality of organizing the spaces (Kunnawar, 2009-2010, p.3). In other words, the lexical meaning of transparency describes the quality of those materials that light passes from inside them and its applicable meaning describes the perceptive quality that mind permits to distinguish between different spatial concepts (Ascher, 2003, p.3). Forty, Adrian has accounted transparency as the key words of twentieth century. He propounded that the word of transparency is applied extensively among architects of the world and while, the world's architecture rarely has sought the analysis of the precise meaning or application of it (Forty, 2000, p.286). The theories propounded about transparency are as one of the most main properties of theorization in our time (Forty, 2000, p.286). Among these theories, Zigfrid Giedion propounded that transparency is a fundamental quality from an artistic product which can return to its artistic and architectural origin (Giedion 1962, p.62). According to another expression about transparency which is often applied in the architecture of most points of the world, it is as a traction or attraction in creating the succession of spaces inside and outside the building (Forty, 2000, p.286). The transparency principle has been from the important principles of existence and it means permanent movement and evolution of existence from material quality to the spiritual quality. Since, the transparency principle is one of the principles of existence, it will be natural that in the general procedure of the world, this principle is also governing and it is true (Mirmiran, 1996, p.1). By a review on the most initial and oldest buildings of architecture and urbanism in Iran, we find out that for more than 3000 years, some elements of Iran's architecture design still have remained sustainable and they have been converted to some principles in Iran's architecture, one of these principles is the attempt of this architecture in line with reaching to the spiritual quality from material quality or in other words, moving from material to the soul and in architectural expression, by lessening the mass, it has moved toward increase of space. If we accept that such a principle has existed in Iran's architecture, with a meaning, we will have a large instruction for today's architecture which is never less than the principles of large architects' statements that we can rely and work on it. One important feature of such a principle, namely, the principle of moving from material to the soul through
lightening and lessening the mass and increase of space is this case that isn’t presented by time and place anymore. Because, whatever is presented by the place and time, doesn’t have constancy and has the expiration date. But, Iranian architecture has those principles which have the sustainability and constancy. These principles are sustainable and wherever they are converted from form to the concept or in other words, from objective qualities, reach to the mental qualities, they gain more sustainability and constancy (Mirmiran, 1996, p.1).

The history of transparency in Mirmiran's opinion:
Mirmiran believes that Iran's architecture has the constant share for 3000 years in evolution of the world's architecture, other architectures like Egypt and Greece's architectures have had share in the limited periods, of course, the Europe's architecture also has more constant share. From Ziggurat Ghagha Zanbil, Achaemenian palace, Sasanian fire-temple to Saljoughi mosque, Safavi palace and even Qajar era with construction of mosques and schools, it has had share in evolution of the world's architecture. But, nowadays, it doesn’t have this share and this disturbance always has existed in these one-hundred years and has made the formalist mistakes in these years. Iran's architecture has the heritage of 3000 years of compiled architecture, in order to be able to have a share in the world's architecture again, being solved in western architecture isn’t the solution, rather, it can create a new idea by understanding the issues of time, taste and color of its territory correctly. In this manner of encounter, the superficial and apparent elements of the past architecture don’t have any application, rather, the dominant morale of the past architecture, culture and territory, climate, shining sun should be applied in the projects (Afshar Naderi, 1995). Perhaps, it can be said courageously that the architecture has been able to approach to this look to a high extent. Mirmiran, Seyed Hadi generally has re-explained three principles of Iran's architecture traditions in his works: Simplicity of outside and mobility of inside, light, transparency and lightness, even in some of his works, the literal roots can be also found. Not necessarily, the «critical regionalism» point is the beginning of many works of him for example in architecture, rather, it can be in any element of climate, culture and region of Iran. In his opinion, a thing which has been transferred to the future from the forms, patterns, arch types, is an attribute-like, «transparency» isn’t very scheduled, forms can be scheduled, patterns are scheduled less than the forms and the thoughts are scheduled less than the patterns, attributes are also less scheduled and can be in the evolitional stages (Etsem and et al, 2010).

The history of structure in the conservatories
Since the beginning of 1800, the architects have been experiencing the new methods by using of frames made of iron to find a proper substitute for using of stone, brick or wood in the building. Using of iron and cast iron pillars was the first step in this line. Later, the architects could construct firm and light buildings by using of metallic frame-work. In 1840, the architects by using of profile, could construct crystalline palace, a building that with an extensive opening mouth and excellent lighting was a place for exhibition and a building which was in fact as a large hall than a conservatory. Later, in 1960s, the architects constructed their special conservatory and exhibition spaces by using of the pipe and ball joints. In the meantime, other architects created similar spaces by using of steel and cable network. With regard to this issue that in the conservatory environments, the conditions are in a manner that cause the corrosion and trituration of structure, coverage and other existing installations under the crust of conservatory, this issue is more serious about the structure. The construction technology in this case has special importance. Nowadays, with progress of technology in the construction (building) industry, lighter and firmer structures are constructed. For this purpose, in order to study the procedure of progress of structure in the conservatory buildings and similar ones (halls), we study the following buildings briefly.

Proper coverage for conservatory spaces
The most important property of conservatory coverage: it has caused that the most amount of light and temperature of sun to pass from it and reach to the plant. In none of coverages kinds, transferring the light and temperature is 100%. Because, anyway, a part of light is reflected or absorbed by the coverage. Among different coverages, glass in terms of the light passage has the first position and the conservatory nylon is in the second position after glass.
The first conservatory building constructed from dome and metallic pillar (cast iron)

Paxton’s Chatworth Conservatory 1837
Sir. Joseph Paxton constructed a large glassy conservatory by using of architecture woods-iron-cast iron and glass. He used of roof-truss system which was inspired from the white lily of Amazon waters

Royal Botanic Gardens KEW Palm Dome 1848
This artistic building which has been constructed by Decimus Burton and Irish ironfounder Richard Turner in England and it is still standing. The structure of this conservatory has the metallic Victorian decorations.

Crystal Palace 1851
Sir. Joseph Paxton designed and constructed his famous building in less than 10 days. A building which became the exhibition center in England. This building was ruined in fire later.

KEW Temperate House 1865
This building which has been designed and executed by Decimus Burton is in the neighborhood of Palm House and it is in the form of a pair of buildings.

Phipps Conservatory 1893
One of the largest exhibitions that its structure is like the conservatories structure, has been constructed by Phipps and in Schenley Park

New York’s Crystal Palace 1902
This building which is used in New York and as exhibition, is like a triangular cap that its additional parts are in in the back part of it

Image No.2: a façade of Paxton’s Chatworth

Image No.3: a façade of Royal Botanic Gardens

Image 1. A part of Victorian decorations in Royal Botanic
Glass:
Till before 1950, only the glassy conservatories existed. Nowadays, these conservatories are accounted as the most expensive kind of conservatory. Since, fuel consumption is high in these conservatories, they need the firm skeletons. Depending on the width of conservatory, different skeletons can be used for its building. In the width less than 6m, wooden skeleton without need to the middle pillars is usable. For those conservatories with width up to almost 12m, the pipe skeleton without need to the middling vertical pillars is applicable; but, for firmness, they should be adjoined to the windows frame. Nowadays, conservatory with glass coverage is from the most expensive kinds of conservatories and although, such buildings withstand hundred years or even more than this by correct maintenance, but, high costs of construction and maintenance of them in addition to more difficulty for construction of them in comparison with conservatory nylon has caused that most of producers of conservatory products to tend to use of this plastic coverage.

The plastic coverages:
The plastic coverages can be made of Poly Ethylene, Polyester, Poly Vinyl Chloride (P.V.C), Poly Vinyl Fluoride (P.V.F). From the advantages of these coverages is lack of need to the heavy skeletons and reduction of the cost of heating up to almost 40% in comparison with one-layer glassy conservatories. Nowadays, the plastic conservatories allocate high percent of the world's conservatories to themselves. Most of the rubber coverages have been from the kind of poly ethylene which have been usually mixed with the material resistant against Ultraviolet ray (UV) that in this event, their life span can be increased up to about 3 years and this product is produced with high quality in the Work Plastic Company. Nowadays, Poly Ethylene conservatory nylon is used for two reasons:
1-This plastic can be applied on permanent skeletons of conservatory which is a remarkable saving with regard to the cost of glassy conservatories. Even, nylon can be used on short-lived skeletons like those which are applied in Quants conservatories.
2-The thermal cost of these conservatories is 40% lower than one-layer conservatory or FRP conservatories.

Methodology
One of the methods of cognition of architecture concepts is to study that concept in the building body which has been organized according to the applicable, cultural and social necessities. The western contemporary architecture meantime enjoying of a high number of manifested samples of transparency concept, has been able to present numerous materials, crusts and structures. According to this, in this research, by using of documented and library studies, at first, the theoretical frame of relationship between transparency and creation of space has been formed. In this line, by using of the approach of descriptive-survey analysis according to the prominent samples in architecture art, the criteria and indexes of transparency will be compiled based on reduction of material and increase of space. Finally, an analysis is accomplished according to these documents and findings and also existing and similar samples. The methodology is qualitative with approach of descriptive survey analysis; the transparency index related to Iran's architecture and urbanism has been compiled. In this research, collection of the needed information has been done in library form. This information has been searched in the theoretical, mystical, Islamic, historical, cultural, climatic, social, somatic domains and determination of the concepts principles. Also, it has been done by using of the information banks existing in the libraries and interviews with expert professors in the field of transparency, reduction of material and increase of space. The method of information analysis is in the form of information classification which scans the qualitative and quantitative affairs and proportional with the research subject, studies the problem in explanatory, inductive and deductive form. Wisdom, logic and reasoning will be also used.

Discussion and findings of the research
Real transparency in architecture:
Peter Reese in his book named "glass in structure" divides the transparency according to time order into three groups which consist of:
• First kind-manner: One-sided transparency, it can be known as the result of a direct need to the permission of entrance and penetration of light to the building coverage which has been often covered by a thin membrane of semi-transparent materials and small pieces of glass and it is used applicable in the openings and walls opening or rigid roofs and wherever visual connection between outside and inside plays less role.
• Second kind-manner: Two-sided transparency: It is in fact the developed and formative kind of the first kind-manner which has been created as the result of technological development and practically enlargement of the glassy pieces size and practically could provide better vision to the outside. Moreover, this kind of transparency can be considered aligned with concepts like visual connection, relation of inside and outside and objective definition of simultaneous perception of different spatial resting-places.
• Third kind-manner: Transparent page: It not only includes the vertical direct surrounding, but also, it is clarified in other dimensions. The clear sample of this kind of transparency can be searched in the glassy and plastic pages, those pages that in the least environmental interference in addition to provide the aesthetic features of a building, create a volume of pages that especially in the façade, it has provided the relation of outside and inside in the best form and somehow organizes the procedure of passage from material-removal in comparison with the volume of organization.

Two-dimensional transparency, three-dimensional transparency:
This kind of transparency can be explained about three concepts of ground, foreground and background in two dimensions and then consequently in three dimensions according to the overlapping of lines, shapes and volumes on each other in an order that this overlapping in architecture is appeared in two-dimensional form practically in plan and set of façade lines and publicly on a surface. While, in three dimensions, this kind of overlapping and practically receiving the ground can not be collected and compressed that this important issue can be known as the founder of interaction between transparency and meaning, because, three-dimensional transparency finally has been related on mental interpretation and visual perception of user directly and this mental process suggests the circumstances of legibility, lightness and connection. On the other hand, Slatzky's view and exposure to the concept of definable transparency practically has considered the attitude of user as the fixed and immovable observation in comparison with façade and plan, while some theorists like Giedion and Moholy Nagy propose the belief in spatial perception and movement of human over time and in the heart of architecture space that automatically explains the transparency definition in combinative domain and structure based on presence in the space in two forms of immovable and movable that occur both physically and perpectively.

Transparency in the meaning:
Transparency in the conceptual and somatic dimension:
Whatever is reminded about transparency in the meaning in western contemporary architecture, has been taken from physical expression methods like walking, turning the look, concentrating,… during observing the images and spatial perception that in a way leads to the semiology and narration of meaning and in the meantime, architecture in its conceptual and somatic frame gives connection and depth to the space by giving dimension and creating protrusions and niches. While, transparency in the meaning in the meantime of creating a permanent relation, indicates or transfers a thing, message or sense to the user in the environment. As for a sample in Barcelona Pavilion Mies Vander Rohe, semiology seeks to find the mechanisms of generation and reception of meaning through sign systems, with help of somatic tools like material, circulation, method and manner of space arrangement, visual connection, reflection and even shades, in combination with transparency, semi-transparency and non-transparency, it generates special meaning and a translation of spatial concept.

The manner of using of solar energy in architecture
In the active solar systems, for guaranteeing the comfort level of heating, cooling, humidity,…, the energy-saving technical and mechanical equipment, installations and regulations or those installations systems which work with renewable energies of environment (sun and wind energy) are used. These systems include use of solar energy collectors that using of these intermediator equipment can cause flexibility in saving the energy. These systems include the following cases:
A: Photovoltaic cells: They are energy generator systems that without utilization of stimulator and chemical mechanisms, generate electricity from sun light radiation. In other words, these systems without consumption of fossil fuels, with natural energy and 5 capable photovoltaic cells with proper design can be applied in different parts of building such as, on the roof, façade and sun visor of window.
B: Solar collector: The performance of solar collectors is in the following form:
The solar heating system in this method includes hot water (solar) collectors which have been situated on
the roof. During the day, by sun radiation, water is heated and by a flow pump, it is conducted inside the
storage reservoir and by another pump, it is flowed inside the air conditioners which have been installed in
different parts of the building and cause to heat the air inside the building.
The solar cooling system: In this system, (by using of active solar heating), solar collectors, storage
reservoirs, a cooler device of absorption cooling system and an auxiliary pot create a cooling system for
summer and cooling the building.

Image 2. The manner of using of solar energy in architecture

The static solar system:
In this kind of solar inactive systems, the buildings are designed in a manner that the need of heating,
cooling and lighting is satisfied naturally and with help of the region's climate abilities. For this reason,
they are said inactive systems and in these states, they will cause the need to activity of heating and cooling
devices to reach to its minimum (A. Haj Seghti, 2009). This method of designing depends on renewable
energy. Therefore, providing the heating energy needed for building can be considered through solar
radiations, conduction and displacement of heated air convection through this way. To gain the energy,
some stages should be considered such as absorption of energy from the intended place, storing it in a place
which is usable later (proper time of access) and finally, distributer unit of energy in the intended
environment and in the desirable volume and quality of human's life (Ardehali, Mohammad, 2002). With
help of control of this system which is necessary in life span of building, we can be sure that its functions
have been done well and we achieve our final aim. Finally, we will reach to the remarkable saving in energy
consumption. One of the most important and applicable equipment in this part includes windows exposed
to the sun and roof light-absorbents which can cause the sun light enter to the life space directly. Trombe
walls, water wall, water roof, solar conservatories and heating siphons by indirect method and string the
energy in the space created between outside and inside walls of building have had the possibility to store
the sun light and conduct it to the inside in proper time and by intended control. Some of the most important
solar static systems can be introduced as follows.

Solar window system:
The solar window system is in fact the same way of direct absorption and it is said to a window which is in
the southern façade of building and the sun light through it enters to the internal space directly. In this
system, the life space acts as the receptor of energy. Trombe wall undertakes the duty of collecting and
storing the heat by indirect method. The energy exited from sun has smashed to a mass of materials which
is between internal space and energy source and this energy is absorbed to it, then, it is transferred to the
internal spaces. In the middling of trombe wall, there are materials which have the property of collecting
the heat in themselves and with some distance from the wall, glass is situated. Water wall is also one of the
kinds of static systems indirectly. In the water wall instead of solid building materials as the collected heat
mass, some liquids like water are used. The absorption and collection walls either in the form of water
(wall) or building (wall), in both states have a glassy wall in southern part of a building that the intended
wall is in back part of this glassy wall (Ghiabaklu, 2012).
Solar conservatory:
The solar conservatory space as an intermediator space between natural environment and somatic space is for regulating the internal conditions especially optimizing the internal air. Double-glazed windows or transparent plastic are proper for this work. The wall between conservatory and living room should be with high thermal capacity (water wall or Trombe wall); in selecting other materials, the freedom of act is more. By good design, all radiations entered to the conservatory are converted to the heat and in this event, the efficiency is 60% to 75% in winter and the amount of heat transferred to the rooms is 10% to 30% of radiance energy that by adding the mechanical collector system, this amount becomes more.

Conclusion
The studies accomplished in the research background of Iranian architecture in the spatial transparency domain express that the architecture of this territory has constancy (sustainability) in terms of content and body in numerous historical periods and as Mirmiran says, it has had share in all historical periods. The evolutional procedure of architecture clearly indicates that it always has attempted in reducing the mass and increasing the space. This principle also has been indicated both in the western architecture and Iranian architecture. From another view, by considering this issue that transparency has direct relation with luminosity in building, it seems that whatever is an expression of light and transparency in western contemporary architecture, is gained by passage from visual perception origins to the induction of spatial concepts and meanings. While, according to the research aims, it can be noted, by studying different buildings and especially valuable buildings of modernism school, it should be expressed that by being informed of schematic patterns and features of different kinds of transparency on one hand and dominating on the somatic and conceptual needs of a design on the other hand, designing and similar and coordinated structures of transparent architecture with special meaning and of course public meaning of it can be achieved. While, according to the accomplished studies, whatever is needed in designing and translating the transparency in the building body, is the need of designer to be informed of properties, features and patterns of used transparency and its effects on definition and limitation of space that will be resulted regardless of different kinds of opening and materials in the building, so that a transparent architecture is formed by knowing the domain of aesthetic, functionalist and semantic needs and of course, the necessity of presence of light inside the building; and by transformational organization corresponding to the physical and perceptual body, it inducts the spatial indexes of transparency like dynamism and fluidity, constancy and connection, relation between inside and outside, material-removal and lightness, flexibility and compatibility, utility and legibility, and spatial opening in the meantime of providing the light and luminosity.
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