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In the Name of God

Dear Readers,

I, on behalf of the editorial board, am proud to present this issue of the *International Journal of Applied Arts Studies (IJAPAS)* under the sponsorship of the Islamic Azad University, Yazd Branch. We were driven to found the *IJAPAS* by a noticeable lack of journals, in the Islamic Republic of Iran in particular, devoted to architecture, urban design, urban planning, architectural conservation and restoration, painting, art history, graphic, digital arts, fashion design, performing art, industrial design, aesthetics and semantics. Although the academic world is increasingly driven by cross-disciplinary visions and models, we seek multi-disciplinary views, an attempt to inform researchers, graduate students, and professionals about the trends, ideas and innovations being put forward in applied arts. To this end, in addition to standard articles, in every volume of the *IJAPAS* we hope to provide a special issue related to a respective field with innovation.

We are also sending out a call for papers related to *Applied Arts* to appear in the next issue of *IJAPAS* in Feb – Mar 2021.

Finally, I should mention that we are committed to a speedy refereeing process for every article submitted to us. We effort to reply to all papers submitted within five weeks' time with a response about acceptance or rejection. We also do not require formatting for submissions in our style until *after* the paper has been accepted by us for publication.

I would like to thank our Editorial Board for their work so far in helping to establish the *IJAPAS*. And, finally, I would like to extend my deepest gratitude to Dr. Ali Boloor, the assistant editor of the *IJAPAS*, for all of his hard work to ensure the timely completion of the issue.

I am delighted to invite you to visit us at www.ijapas.org.

Sincerely,

Dr. Abolfazl Davodi Roknabadi
Editor-in-Chief
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Meaning Creators: The Communicative Power of Language and Conceptual Art via Fashion Phenomena

Ayoub Hojjat Shamami[a]*

[a]*Master's of Art History, Universiti Teknologi MARA (UiTM), Faculty of Art and Design, Malaysia*

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Abstract

Conceptual Art was an avant-garde movement that gave special attention to the idea, meaning, and concept rather than the beauty, form and art piece. From the early days of the movement in the 1960s, Conceptual Art and language have tied together. In fact, some conceptual artists attempted to make a bridge between language and art. Language offers many artists, such as John Baldessari, Joseph Kosuth, and Jenny Holzer, a lot of possibilities to convey their provocative messages to people. In this way, they succeeded to engaged people directly. This communicative power of Conceptual Art and language has inspired the design world, in particular, the fashion world. The purpose of this research is to investigate the connections between Conceptual Art and language in fashion. At first sight, it seems that there is no relationship between Conceptual Art, language and fashion phenomena. Because fashion is a big business and selling products play a vital role for fashion designers. On the contrary, in Conceptual Art, the concept or the idea is more important compared to the final product and market needs. This paper will also discuss how some fashion designers succeeded to show the relationship between Conceptual Art, language and the final product. It can be concluded, for these fashion designers, fashion is beyond the clothing itself. Through language, they become a kind of meaning creator which is the ultimate goal in Conceptual Art.

Keywords: Language-Based Artwork; Conceptualism; Fashion Phenomena; Meaning Creators

* Corresponding author. Tel: +98-9125248966.
E-mail address: ayoubhojjat@gmail.com.

1. Introduction

The Bauhaus historical significance can be a good point for our discussion about the communicative power of language and Conceptual Art via design world, in particular, fashion phenomena. With no doubt, the Bauhaus was one of the most significant and the world's top art schools in the last century. It was established by German modernist architecture Walter Gropius in 1919 and was closed by the Nazi totalitarian regime in 1933. But their influences on people's social life have remained until now. The Bauhaus main purpose was to integrate manufacture, art and people's necessity in an advanced society. Due to this cause, the Bauhaus introduced and popularized design for the general public. This cultural movement has influenced the design world from graphic design to fashion and furniture design.

Interestingly, some of the most influential artists of the twentieth century such as Wassily Kandinsky, Johannes Itten, and Paul Klee worked there as a lecturer. These artists played a very important role to make a bridge between aesthetics and modern machined design. The Bauhaus aesthetics had more emphasis on abstraction and geometric forms. Despite classical aesthetics, in particular, Plato's aesthetics on art, craft and its unimportance, the Bauhaus placed a high value on craft and craftsman. According to Walter Gropius "The ultimate aim of all artistic activity is building. Architects, sculptors, painters, we must all get back to craft ... The artist is a heightened manifestation of the craftsman" (Denervaud, 2008: 118). In this way, the Bauhaus succeeded to make a connection between aesthetics and modern design or unification between art and craft.

The modern design phenomena have interwoven with aesthetics and art, particularly in the twentieth and twenty-first centuries. For instance, the fashion phenomena and art movements have a very close association together. As proof, here are some examples; Yves Saint Laurent who was one of the most significant figures in fashion history inspired by geometric abstraction especially Piet Mondrian's paintings. In addition, abstract art and Abstract Expressionism have a strong ability to convey the feeling to the spectators. This could be a good reason for many fashion and interior designers to use abstract elements in their designs. For instance, some fashion designers such as Stella McCartney, Elie Saab, Gucci, and Hermes are inspired by abstract art, in particular, Abstract Expressionism. They have tried to capture the soul of abstract art and express it through their design.

In a post-modern design especially in furniture design, Memphis Design Group was one of the most innovative and influential groups in the body of the design world. They were inspired by Art Deco and Pop Art to create their own language in the design realm. As a result, the Memphis Design Group simplified the forms and created extremely colorful furniture with a smooth line. According to Demir Barlas "they introduced postmodern themes and motifs such as kitsch, bright color, and humor into furniture design, to embrace the industrial and popular in the mode of pop art" (Barlas, 2009: 664). The design world is greatly influenced by art history and aesthetics. This inspiration is not limited to Art Deco, Abstract Expressionism, and Pop Art.

Conceptual Art applies to diverse types of artworks and it developed in the early 1960s. But the historical significance of Marcel Duchamp for a movement like Conceptual Art must not be overlooked. Marcel Duchamp's works, in particular, readymade, had one the most significant impacts on Conceptual Art. Duchamp is very famous or infamous for his readymade. Readymade is not more than an ordinary artifact or commonplace object which Duchamp took and put it under different circumstances. In such a way, he tried to create a new meaning for our daily life objects. Readymade as an output for Duchamp's creativity changed a lot about the context, meaning and, concept of art. He opened a new horizon for the aesthetics qualities. For Marcel Duchamp the main point is that readymade can be conceptualizing in a place where objects of value are kept. As a

result, the fundamental meaning of art changed substantially. In general, the beauty, narrative, artistry and skillfulness are vital in the traditional definition of art but Marcel Duchamp denies all these influential elements. As Guillaume Apollinaire, French poet and art critic recognized Marcel Duchamp as "liberated from aesthetics preoccupations" (Acton, 2004: 65). This is the main characteristic and the most significant aspect of Marcel Duchamp's artworks.

In Marcel Duchamp perspective the concept behind the readymade is the most important element. In other words, the mental concepts played a crucial role for him. The mental concepts, Conceptual Art and language have a direct connection together. As Michael Newman stated, "The attempt by Conceptualism to make a shift in emphasis from aesthetic questions to ontological problems, as Marcel Duchamp had tried to do, was the source of art's linguistic turn" (Newman, 1999: 132).

Henry Flynt as an American thinker and musician was the first person who used the term concept art in the early 1960s. He believed that concept art is a kind artwork which its essential element is idea and meaning. According to Henry Flynt "Concept art is, first of all, an art of which the material is concepts, as the material of e.g. music is sound. Since concepts are closely bound up with language, concept art is a kind of art of which the material is the language"(Morgan, 1994: 118).

Conceptual Art was a movement that began in the 1960s concurrently with Performance Art, Psychedelic Art, and Fluxus. It was an avant-garde movement that gave special attention to the idea, meaning, and concept rather than the beauty, form and art piece. In fact, a conceptual artist uses the form of artwork as a vehicle for his or her idea. According to Alberro "Conceptual art is made to engage the mind of the viewer rather than his eye or emotions"(Alberro, 2000: 15). Since the beginning of the movement in the 1960s, Conceptual Art and language had a very strong connection and they have tied together. Indeed, some conceptual artists try to make a bridge between language and art. These conceptual artists, such as John Baldessari and Joseph Kosuth, believe that language itself can be a form of visual art. As John Baldessari once said, "Language seems to me to be a very viable material to use in a creative way"(Bruggen, 1990: 69). In this way, they employ language as a medium to express their thoughts and ideas to spectators. For these artists, the function of art and the role of an artist are completely different in the postmodern age. For them an artist is more like a theorist and thinker who develops theories, not like a skilled worker and artisan.

Generally speaking, in the postmodern era the world of art is influenced and inspired by globalization. As a result, art and design are not bound to any specific medium and national boundaries. For example, the contemporary fashion phenomena are influenced by conceptual art and language. But the main questions are; how fashion phenomena are inspired by conceptual art? Is there any connection between fashion design and language, For instance, in Nima Behnoud and Katharine Hamnett's works?

2. Jenny Holzer: Text-Based Artworks and Public Debate

Jenny Holzer is one of the key figures in the contemporary art scene, in particular, Conceptual and Installation Art. Since the beginning of her career in the 1970s language and text have played a very important role in her artworks. For Jenny Holzer, the main medium is language because the use of language can help her to fully and clearly engage ordinary people. She believed that communicative power is the most important characteristic of language and text. As she stated, "I *used language because I wanted to offer content* that *people—not necessarily art people—could*

understand" (Ross, 2014: 173) . Indeed, for Jenny Holzer as the phraseology of multimedia artist language can be seen as art.

She has placed phrase and language on electronic signs especially L.E.D. Because, for Jenny Holzer, the public space is so important and no one expects that these flashing L.E.Ds or Advertising boards are artworks. People are anticipated to see advertising on the L.E.D signs but Jenny Holzer consciously uses L.E.D technology as an unexpected context to convey her message to the people. The contents of her artworks are disconcerting and people automatically start to think about the meaning that hides behind these phrases. As Joan M. Marter mentioned about Jenny Holzer artworks "commercially printed in cool, bold italics, numerous one-line statements such as "Abuse of power comes as no surprise" and "There is a fine line between information and propaganda" were meant to be provocative and elicit public debate"(Marter, 2011: 532) . In this way, she makes a linguistic bridge between her artworks and Conceptual Art.

There is a connection between Jenny Holzer's language-based artworks, fashion and the public space. For Jenny Holzer, the pubic space is so significant because she can easily convey her provocative messages to the general public in society. At the same time, fashion and public space have a relationship together and usually, people wear their fashionable clothes to show it in public space. In other words, public space has the same value as the private space for fashion designers.

The public space can be a significant common ground between Jenny Holzer and fashion. As a result, her artworks inspired some fashion designers. For instance, we can see the impact of Jenny Holzer's artworks on American fashion designer Virgil Abloh and his Milan-based label called Off-White. Another example is Keds Company which produces canvas sneaker and that shows how even some shoe designers influenced by her artworks. Jenny Holzer created one of her most significant series called Survivor Series in the 1980s. Among these one-line statements is a phrase called "protect me from what I want" which has had a tremendous impact around the world (Fig 1). After almost three decades Japan-based fashion brand Uniqlo produced some T-shirts based on Jenny Holzer flashing L.E.D artworks, in particular, Survivor Series (Fig 2). Make people think is the ultimate goal for conceptual artists. When ordinary people see these clothes in the public places, undoubtedly begin to think about the meaning of these statements. In this manner, Conceptual Art generally and Jenny Holzer's artworks particularly have inspired the fashion world.

Fig 1 Jenny Holzer Survival Series Times Square NY 1986, Source: (URL1)

Fig 2 Uniqlo men sprz NY graphic 2010, Source: (URL2)

3. Katharine Hamnett: Political and Environmental Messages via Fashion

The British fashion designer, Katharine Hamnett, clothing design is a perfect example of the connection between language and text with fashion. She consciously uses fashion as a medium to remind us our social-environmental responsibility. As Taryn Benbow-Pfalzgraf mentioned "Hamnett's most important contribution to fashion, and the one for which she will best be remembered, was her use of clothing as a vehicle for political and environmental change" (Benbow-Pfalzgraf, 2002: 295).There is no doubt that, among all her designs, the slogan T-shirt has the most unique and influential role (Fig 3).

Fig 3 Slogan T-shirt by Katharine Hamnett, Source: (URL3)

She has demonstrated her concerns about political and ecological changes via language and words. Language has played a very important role for her and it has same power and value as image. Because of that such as a radical conceptual artist she minimized beauty and artistic taste of her slogan T-shirt. She employs language and text in black bold print on a white background to directly convey her messages to the outside world. These catchy phrases in her clothing design is not just a formal or design element. She is fully aware of the sociopolitical power behind language which can easily affect people. Katharine Hamnett and her clothing design can be interpreted as a speaker who tries to warning hearer.

Katharine Hamnett has same idea with some conceptual artists such as Joseph Kosuth and Jenny Holzer because the idea and meaning behind the language and text in her design are so significant. In this way, she is so close to Joseph Kosuth's idea about language. As Franz Schulz mentioned that "Kosuth believed the use of language would substantially redirect art away from appearances and even aesthetics, and toward ideas" (Schulze, 1998: 163). For both artists (Joseph Kosuth and Katharine Hamnett) the idea is the fundamental element for creation. Indeed, the idea has the highest value and the visual elements and aesthetics have the lowest value.

Also, the idea behind her design is so close to Jenny Holzer flashing L.E.D artworks and its concepts. According to Peter Goldie "Jenny Holzer has used her language-based works as a vehicle for passing provocative question about a wide range of topics in modern life" (Goldie, 2009: 85). Katharine Hamnett's attitude towards fashion is the same as Jenny Holzer's attitude towards conceptual art. Both artists propound some serious questions about social, political and environmental problems in modern life. With the rise of the modern world and life, we are witnessing some unique problems, from social, environmental, and political to even ethical, which are related to our time. These artists through their language-based works are warning the public for the dark future.

4. Nima Behnoud: The Memory of Iranian Contemporary History via Fashion

Nima Behnound is an Iranian New York-based fashion designer and also the founder of the NIMANY brand. Throughout his career, he tried different mediums, but finally, he chose fashion design as his main interest. As Sol LeWitt once said, find the best form for the idea, Nima Behnound finds clothing design as the best form to convey his ideas.

The letter "H" played a very crucial role in the Iranian modern and contemporary art scene, in particular, in Parviz Tanavoli's *Heech* (Nothing) Series. The letter "H" has sad but eye-catching form. Annemarie Schimmel believed that the letter "H" traditionally conveyed a sense of melancholy. According to Annemarie Schimmel "The contemporary Persian sculptor Tanavoli has very well expressed this sadness of "H" in his delightful variations on the word *Heech*"(Schimmel, 1990: 139).

In opposite, Nima Behnound consciously gives a new meaning to the letter "H" in his clothing design. According to Nima Behnound, the letter "H" is not just a simple letter. The shape of this letter has unique geometry and structure. In terms of formal element and aesthetics, he believed that the letter "H" simultaneously has both negative and positive space. This contrast between positive and negative space creates an object with balance and beauty. In terms of meaning, despite Parviz Tanavoli's *Heech* (Nothing), this letter refers to the word everything in Farsi language.

In another series called The Revolution Series, Nima Behnound used newspaper clippings to create his series. Nima Behnound's The Revolution Series can be a good example to explore the role of language and conceptual art in fashion phenomena. Indeed, Nima Behnound's The Revolution Series can be regarded as an attempt to provide an insight towards the relationship between language and conceptual art in fashion.

In this series, the design is based on a newspaper font which is so industrial compare to the traditional calligraphic font. In this way, he succeeds to create an industrial aesthetics using a newspaper font. Also, another important element is the meaning behind theses newspaper articles which are related to the Iranian Revolution in 1979 and Iran-Iraq War 1980 to 1988. The example of NIMANY's The Revolution Series can be seen as follows:

Fig 4 NIMANY, the Revolution Series, Source: (URL4)

Nima Behnound believed that his design is a wearable art. He mentioned in 2010 in an interview with Daisy Carrington that he decided to put theses newspaper articles on a T-shirt – everyday wear – because people could wear the message every day. The Revolution Series can be seen as an expression of social and political messages via clothes in the Iranian context. Indeed, The Revolution Series is the memory of Iranian contemporary history and also an invitation to think via fashion design. Because The Revolution Series is more about the meaning and the artist wants to ask the spectators to seek and hunting the meaning.

5. Conclusion

In this study, I intended to examine the relationship between the subjective world of language and Conceptual Art with the objective world of fashion. At first glance, it seems that there is no connection between Conceptual Art, language and fashion phenomena and they belong to two different worlds. Because in Conceptual Art, the artist's mind and thoughts is more significant compared to the final product or the artwork. As a result, the market does not play a crucial role for the artist. As Maria A. Slowinska mentioned, "Conceptual Art strove towards an ideal of art that was as removed as possible from the art market and from any market-driven possibilities for its exploitation" (Slowinska, 2014: 148). In opposite, fashion is a big business and industry, in each business, the market has a significant role and selling product is so vital. As Mike Easey stated that, "ability to identify product that the consumer need and will buy is essential to the industry"(Easey, 2009: 5).

Some conceptual artists convey their messages and ideas through language. Despite some differences among conceptual artists, there is a significant common ground between all of them.

This common point is that all conceptual artists are a meaning creator. In general Conceptual Art can be considered as the analysis of meaning via language. In other words, the meaning of the object forms the core of art not the object. Conceptual artists can use fashion as an instrument and different mediums to convey their messages. This includes some fashion designers such as Nima Behnoud, Katharine Hamnett and a conceptual artist like Jenny Holzer. The main goal is to create wearable art. For these fashion designers, fashion is beyond the clothes itself. Through language, they become a kind of meaning creator which is the ultimate goal in Conceptual Art. Fashion can be seen as a medium for communication and fashion designers make this communication possible through the written language. For fashion designers who want to exceed the limits, conceptual art and language can be regarded as a good source of inspiration as well as a tool to promote their products.

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The Role of Virtual Theatre Components on Scenery Quality of Virtual Theatre using Austin Wang's Approach

Sara Noori[a], Mohamad Ali Khabari[b]*

[a]*Ph.D. Student, Faculty of Arts, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[b]*Assistant Professor, Faculty of Arts Jihad Board, Central Tehran, Islamic Azad University, Tehran, Iran*

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Abstract

Audience feedback in modern societies has fundamentally changed primarily due to developments in time and the process of replacing signs of virtual reality with reality has taken place. Moreover, there is an opportunity for a large number of audiences to be recognized and to actively engage with a few limitations. Meanwhile, the designers of some countries, due to the lack of attention to environmental, security, social and economic considerations, which are considered the most important aspects of using this function, have not been able to keep pace with the needs of their audience which resulted in diminishing this art. Therefore, the present article examines the fundamental changes and developments in security, economic and social methods of attracting and experiencing augmented reality and the performance of cyberspace in order to develop theater stage design, considering Austin Wang's works on the concept of place, its essentiality and time in theater. The research method is correlation, and statistical tests of Smirnov's Kolmograph, multiple regressions and Pearson correlation test were put to use so as to determine the relationship, intensity and direction of the relationship between independent and dependent variables. The results indicate that the "sense of helplessness" variable is the most effective variable on the virtual theater stage, and then, the second priority is the independent variable "environmental fluidity" and the third priority which is "color intensity" variable has the greatest impact on the scene. They have virtual theater production, and finally the following fourth to tenth variables are based on similar priority: "space scale and layout", "scene variety", "light quality", "imagination", "sound", "speed of movement" and "sense of innocence" which are necessary for the virtualization of the theater stage.

Keywords: Virtual Reality; Virtual Mis en Scene; Virtual theater; Austin Wang

* Corresponding author. Tel: +98-9125792004
E-mail address: ma.khabari@gmail.com.

1. Introduction

Human life has been always affected by technical developments and new achievements in different fields. Like any other sciences, are is also influenced by such effects. Modern art makes use of different and varied instruments to transfer different meanings and concepts. New computerized technologies play a significant role in dramatic arts dynamically and flexibly (Holten, 2005). Virtual reality has been also influenced both formally and aesthetically by visualized arts, photographic arts, theater and it was the source of many direct and indirect effects on these arts (Zellner, 2009). Although virtual reality has applied other artistic elements in its form and content, it is dissociated from other arts due to its exclusive features including mutual impact, multifaceted relationship between users, and the use of artificial intelligence. It's regarded as an independent art in itself (McEvilley, 2005). Upon the emergence of virtual reality in theatre in the 1960s, the basics of relations in the theatric world had undergone significant changes, and the relationship between space, actor, and audience, changes into the relationship between audience and space (C. Eisenhower, 2009).

Thereafter, the audience didn't ac passively in theatre; dramatic actions have been substituted by real ones and the audience played an active role regarding how to do the actions (Shakener, 2007). Indeed, digital and virtual theatre not only attempts toward preserving values of traditional and classic theatre but also, tries to rejuvenate that because it considers more prominent goals such as attracting a higher number of audiences and responding to the natural needs of the new generation of audiences (Pantley, 2002). Despite the novelty of the branches of digital media, modification and extension is increasingly growing in different domains. The only problem here is not the interaction form of digital technologies with the world of theatre, but also it concerns having an impact on modern performances and changing meaning through the provision of new potentials in expressing ideas; that's because the interactive platform is the main feature of contemporary arts combined with computerized technologies (Nadel, 2013).

Even though digital media is considered as a product which had a delayed arrival in Iran, but insufficient studies have been undertaken to study the basic evolutions and modifications required in security, economic, and social domains to enhance the performance of the virtual world in theatre and especially to develop the scenery design. Therefore, the main objective of the present study is to find out the basic impacts of virtual reality in theatre and especially in theatre scenery design.

2. Theoretical Foundations

2.1. Virtual Reality

Virtual reality is defined as a kind of technology in which a virtual environment will be displayed in front of users; eyes and the user would be able to interact with the virtual world through moving head and body. In other words, as soon as an individual installs a virtual reality headset on his head, s/he will see an environment which changes according to any change in his/her physical position, and the human's mind will gradually learn and accept that it's a real-world, but a virtual one (Cavallo and Couch, 2004). In the physical world, the scales will be measured through the proportion of elements' size to the user; however, in the virtual world, is not endowed with any intrinsic dimension; therefore, the scales in the virtual world will be determined according to the speed of users' movement (Carrol, 2006). Besides, new forms of communities will be formed in the virtual world and they give way to gendered, racial, and existentialist modern relations. In this world, the user would be able to create a new personality for himself, the one which would be

different from his/her gender, race, social class, and the physical world he/she belongs to (Sutton, 2005).

Fig 1 Hologram - Reverse Kinematics is used to express an avatar by recording the movement of the head, wrist and ankle (https://www.dezeen.com/2017/03/07/es-devlin-map-backdrop-set-design-ugly-lies-the-bone-play-virtual-reality-london-national-theatre/)

A virtual reality environment is created by wearing a virtual reality headset and using particular applications. Some of these environments are in the form of computerized and three-dimensional graphics and others are only 360 degrees videos or photographs from real-world which have been recorded recently. This virtual reality capability made individuals capable of watching your location and facilities very well. One of the common mistakes in recalling virtual reality technology is calling it "augmented reality" (Szilas, 2005: 194). Augmented reality is a kind of technology in which the 3-D picture or information in the form of a text or picture will be displayed on a vibrant picture which is going to be displayed through mobile phones' or tablet's camera. Of course, this technology is accompanied by its limitations which slowed down its development and popularity (Alan et al., 2009). On the other hand, virtual reality is the integration of three-dimensional content and recorder pictures from the environment through virtual reality applications and using the cameras located at the back of mobile phones (Szilas et al., 2007: 6).

Fig 2 A virtual exhibition of Van Gogh works (www.worlds - Aerial hoop performer in Emily Carr University Concourse Gallery.com)

Virtual reality has been introduced from the beginning of the 1980s and its environment being developed through the computer didn’t exist, but the audience gained a realized conception from

that. The design of virtual reality wasn't limited to computerized games and this technology is used in different domains nowadays, it dominated different scientific and artistic domains as well as television studios, cinema, and animation and it eventually emerged in theatre which remained unknown so far (Changhoon et al., 2003).

The idea behind using this performance has been first applied in 1990 to experience a fight with full details and this simulation has been first applied by the USA air force (Childs, 2009).

The virtual world is detached from the complexities and difficulties of the real world. It's a kind of environment detached from earthly qualities that don't require material properties and some limited structures of the real world. There isn't any suitable instrument in the virtual world requiring an enclosed level, defining a particular kind of design. Besides, there's no graphic limitation in the virtual world and no boundaries are defined (Darroch, 2008: 96).

2.2. Virtual Theater

The first dominant study which diverted human's attention toward the theatrical quality of human-computer mutual interaction was "Computers as Theatres" in 1990 by Brenda Lorel. Virtual theatre is a simulation of a situation that is experienced by the audience in the real world. Since playing the role of multiple network terminals by playwrights or actors occurred just recently, the virtual theatre not only experiences the observer inside the artwork but also allows him to be present inside the picture and control it to some extent (Coates, 1992).

Though the theatric virtual reality experienced by the audience is the product of simulation, but the impacts of such simulation on the audience are high. According to reality, what is seen and interpreted is the same as a simulated artifact; however, it lacks the real affair which impacts the observer (Dixon, 2006). Furthermore, virtual reality theatre immerses the common temporal and spatial functions in the art. In virtual reality theatre, we're faced with computerized terminals and video monitors, not a distinct existence from here and there (Eaket, 2010).

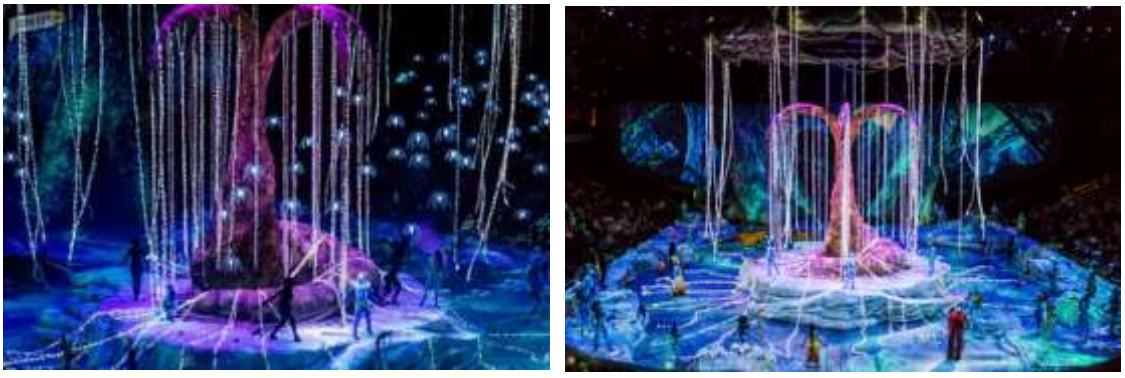

Fig 3 Performing "Sun Circus" in Paris using optical laser and hologram systems (www.Worlds-Avatar dancer holding the miniature avatar of aerial hoop performer)

Thus, the mere existence of virtual reality challenges our conception of space and the world and implements the basic idea and premise of this art, i.e. "being phenomenal" and "commenting on a space"(Eversmann, 2011). As argued by Peter Wible, the media including cinema, video, and finally computer do all concern lack of location, while classic art is solely concerned with location and locating (Glusker, 2006). Another problem to be discussed concerning the design of virtual

worlds is how much they must be real and how much their architecture to be affected by the physical architecture. This architecture must be different from the physical world, on the one hand, to make use of its potentials in the best possible manner and to revitalize the user's imagination through that (Rebelo et al., 2011: 383).

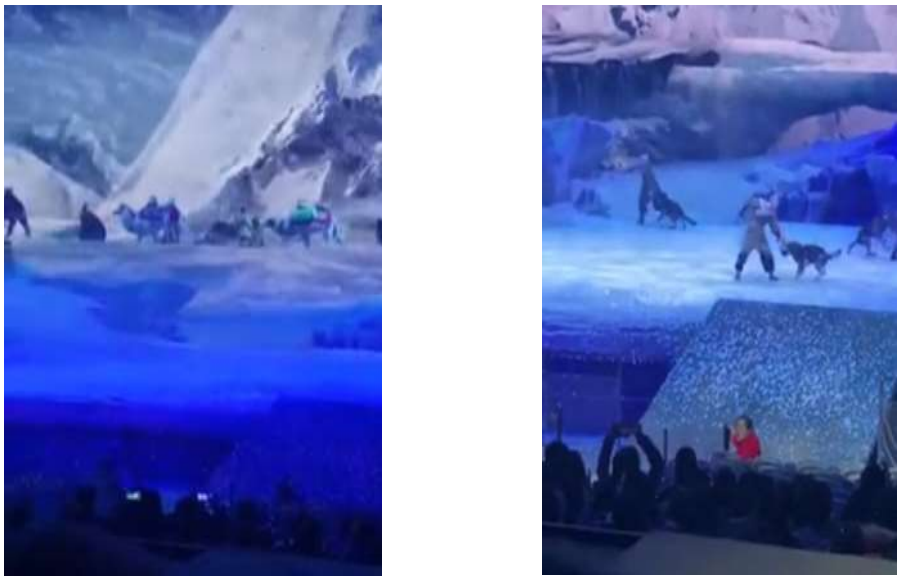

Fig 4 Theater performance with artificial intelligence (www.Picture from Terranova by CREW_Eric Joris (© courtesy of Stefan Dewickere)

Theatre occurs within the constraints of time ad space on the scene, a statute is built in the space, just like an architectural work. However, from the 1840s on, since the emergence of the telegraph, it has been made possible to dissociate the message from its sender. Modern aesthetics concerns a lack of location. Messages are dispatched from a locus to another (Grau, 2003).

Interestingly, virtual reality theatre occurs both in real locations and a new one due to recurrent transfer of the theatrical experience. It undertakes an artistic task. The audience is capable of playing a different role, as part of artistic work and through a location change. The audience will observe a phenomenon in the short run that has a clear beginning, middle, and end (Holloway, 2010).

2.3. Virtual Scenery

The computerized tools and instruments are extensively used in scenery design. The design instruments are all under rapid development and use at the moment (Joff, 2009). For years, the scene designers made use of scene studios which applied technical design function for their architecture; however, nowadays they use 3-D modeling software to create scene models. This 3-D software and applications are used to transform simple designs into realistic designs with an unbelievably high number of details (Milgram and Kishino, 1994).

During the history of theatre, technological innovations incurred different kinds of transformations on scene design, just like stage lighting science has moved from normal lights to electronic ones and developed toward combining lights along with more complex control systems. Lighting and its nature have undergone many changes over time (Lovell, 2000). The spontaneous

and precise changes in lighting quality helped the designers to increase the number of lighting sources and the complexity of control commands. The ease of implementation will allow the lighting scenarios to reflect precise variations including lighting variations throughout the day, roles' psychology, or even the scenery. The most advanced lighting facilities will allow a unified tool to vary the intensity, color, sound, and motion to a new focal point which endows the designers with full flexibility (Masura, 2007).

Fig 5 Performing a theater scene with a hologram system (www.Worlds - Avatar dancer holding the miniature avatar of aerial hoop performer)

Using the new media, one can prepare scenes, in which we'll be capable of changing location and position, just lie the cinema. Accordingly, we can move from a particular time to another and create supernatural spaces that are compatible with the physical rules of the world around us (Onyesolu and Eze, 2011). We'd be able to develop fluid and variable environments displaying the expressionist works of art and combining the character's thoughts. This ode of scenery would exactly transfer the playwright's intentions and mindset to the scenery. Besides, we can intend different locations and realistic for each scene and not producing and performing plays in the same environment (Ogawa, 2001).

2.4. Austin Wang Virtual Scenery

This Thai scene designer has been awarded Cloud Gate as the best artistic achievement through three decades of artistic endeavor in creating extraordinary patterns. Wong was enthusiastic about scene design. He moved to the USA to study in scene design and lighting at South California's School of Performing Arts. He suggests that "a good location can help people with its good performance to appreciate art and culture and it's regarded as an important criterion for the development of each society.

He designs the scene in the "dance of cloud" theatre in the form of a magical room which reiterated its poem. He reproduced an unbelievably artistic scene using virtual technology and the traditional tools for dancing of clouds (Kelly, 2015).

Some moments before the theatre just starts, space will gain a deep light and all the audience will remain silent. The audiences who are waiting for real space will enter another world. In Wong's viewpoint, this is a real play, a symbol of a particular time or space, with both temporal and spatial features being included in the virtual reality and the purpose is to create an integrated outlook and sensation to produce a play. A particular scene design must reflect the scenario's flavor and taste at the same time it interprets the play itself (Packer, 1999).

Fig 6 A scene designed by Wang for drama performances (right); Austin Wang's stage design based on Jimmy Liao illustrated "Sound of Colors" (left) (https://taiwantoday.tw/news.php?unit=20&post=26520)

One of the significant characteristics of Wang was his capability in transferring self-design philosophy and encouraging others to follow its competencies. Che Ko Chien, Wong's colleague argues that "working with Wong is challenging because his designs don't allow me to use conventional lighting styles and overcoming technical problems will deprive me of creativity when a director doesn't like his design concepts, most of the scene designers want to ask "So, what do you want?" but, Wong won't discard his ideas and will justify the scene director about creating a proper atmosphere and feeling for film production." Innovation and his clever use of a rotation stage which will make changes in the scene are always beyond the audience's expectations. He can transfer the audience to a world that is going to be portrayed by the play (Reaney, 2000).

3. Research Background

In his MA dissertation entitled "The Use of Digital Technology in Theatre", Hashemi (2011) studied the use of computerized and digital technologies in theatre. It has been argued in this study that theatre will grow using such instruments as well and will provide a definition of theater in the digital world. Another step taken in this study is the introduction of various theatrical groups being active in digital theatre. Then, the interaction between theatre and technology is investigated and the impacts of technology on scenarios as well as stage design will be elaborated upon. The results illustrated that nowadays the use of digital technologies in theatre will be a continued affair, through which the mentality and emotions will find a better place in the work of art (Hashemi, 2011).

In his MA dissertation entitled "An Investigation of Function and Aesthetics of Animation in Digital Theatre: Practical Implications for the game", Rahimi (2014) investigated the use of animation in digital theatre. To his end, at first, the historical-theatrical evolutions which resulted in the late 20th and early 21st century transformations have been clarified. To clarify animation evolution in this new medium, animation history has been investigated as well. The author

attempted to clarify the boundary between animation and technology by using theatre. By conducting a review of samples of digital theatre as well as performance arts, the author tries to elaborate upon the use of animation in theatre and other similar works of art. The results showed that most of the animation effects used in digital theatre have been previously implemented using optical and mechanical tools and animation developed such effects and made them more influential through the exertion of higher control. The most significant capability of technology and animation for the digital theatre is the possibility of interacting with mise en scène and digitally integrating features of other arts (Rahimi, 2014).

In his MA dissertation entitled "An Investigation of Functions of Digital Media in Performance Arts based on Steve Dixon Theories", Seydi (2018) studies the intended performance form based on Steve Dixon's theories using a descriptive-analytical approach and after a discussion on the definition of digital theatre. The results showed that digital theatre must be capable of being digitized from the beginning. It can't be considered as a digital performance without the existence of digital devices and instruments. Digital performances must be vibrant and lively. Without the presence of any live actor and events in the time dimension, we can hardly be able to discuss it as a kind of performance. Digital theatre must contain verbal elements, without which will turn to dance or musical performance. The use of multimedia technologies provides numerous opportunities for the scene (Seidi, 2017).

In his MA dissertation entitled "Introduction of a Digital Marketing Model in Art Marketing with Emphasis on theatre and Cinema and Investigating its Antecedents and precedents", Akhavan (2019) studied the process of introducing an indigenous digital marketing model in Arts. The main purpose was to study the precedents and antecedents of this model and identifying factors influencing digital marketing in art marketing. The method used in this study was a consecutive mixed one and consists of two qualitative sections at first and a quantitative section follows. In the qualitative section, digital marketing for Arts is presented in the qualitative part using grounded theory and the quantitative part includes the use of a survey and uses descriptive-correlational statistics. This topic has been generalized to society from a statistical viewpoint. The data collection instruments include an in-depth interview and questionnaire. The sample for this study consisted of quality executives of digital marketing organizations and companies, faculty members, and distinguished specialists in different domains of theatre, cinema, and their directors, producers, and audiences. The results showed that two variables have been identified in the causal and grounded circumstances section (including celebrities and development of digital tools) and a variable related to arts marketing has been identified as the focal phenomenon, campaigns have been identified as moderating variable and in practical and interaction section, two variables including content management and social media marketing have been identified which finally resulted in higher satisfaction and loyalty of the audience (Akhavan, 2019).

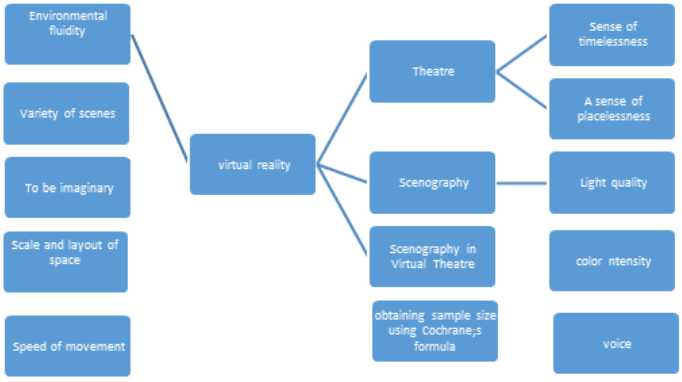

Fig 7 Conceptual model of research

4. Research Method

This study is applied in terms of its purpose. To assess factors influencing virtual theatre, a correlational research method has been used. To this end, the Kolmogorov-Smirnov test has been used to identify the normal distribution of data and linear regression statistical tests, and Pearson Correlation tests have been used to determine the relation and intensity and direction of the relationship between dependent and independent variables (Khaki, 1990: 335). Multivariate regression is a method used to analyze the holistic and individual cooperation within one or more (x) independent variables and in (y) dependent variable. Besides, the coefficient of determination (R^2) or determination correlation coefficient, or the amount of variance explained and variations of the dependent variable through the set of independent variables are displayed as well (Habibpour and Safari, 2009: 48).

After extracting the influential variables from theoretical foundations and conducting a review on related literature, a questionnaire has been prepared and has been used on a sample to study the significance of sing virtual design for theatre scene. Therefore, considering significant study variables including gender, education, socioeconomic status, cultural and political orientation, and the purpose of watching the theatre, participants' responses have been analyzed. Cochrane's formula (with an error coefficient of 0.05 and confidence interval or error percentage of 1.96) has been used to determine the sample size. 151 people participated in this study (male=38%; female=61%).

Fig 8 A schematic representation of the research method

Considering the dimensions and components of the virtual theatre and the discussed indices, 33 items have been designed and presented to the researchers and experts. The number of items reduced to 26 and the questionnaire's validity and reliability has been verified then. Cronbach's alpha has been used to ensure the questionnaire's reliability (r=0.87). The results of reliability coefficients for each study variable are included in Table 1.

Table 1 Reliability coefficient for study variables

Variable	Type of variable	Number of items	Cronbach's alpha
A sense of timelessness	Independent	2	0.873
A sense of placelessness	Independent	5	0.870
Lighting quality	Independent	2	0.868
Color intensity	Independent	3	0.875
Sound	Independent	3	0.863
Environmental fluidity	Independent	4	0.866
Variety of scenes	Independent	3	0.858
Imagination	Independent	2	0.872
Space decoration and measures	Independent	4	0.868
Speed of motion	Independent	1	0.877
Virtual theatre	dependent	4	0.849

Considering Chronbach's alpha value for each of the items, it can be concluded that the internal correlation of the items is high, i.e. project instruments are highly reliable.

5. Study Setting

Tehran's Theatre Complex which is known as Khavaran Theatre is the largest setting of professional theatre around the country which is located in Southeast of Tehran and the vicinity of Khavaran Cultural Center. Khavaran Theatre is the most professional entrance of the theatre in Iran which is built near to Khavarn Cultural Center. It's a cultural-art center which is used as the setting to host different international performance festivals. Khavaran theater has a capacity of 1000 people and it is also capable of holding musical theater, traditional theatre, performing symphonic orchestrates, and musical concerts. Khavarn Theatre includes an open amphitheater space in an area of 3500 square meters which has been included for religious and traditional plays. This theatrical complex has been selected because it's equipped with professional black boxes.

Fig 9 Tehran Theater Campus

6. Research Findings

The questionnaires first enquired individual participants regarding their familiarity with theatre. As evident from the following figures, it measures the number of times one has visited a theatre, their age, and their experience regarding virtual reality. There wasn't any significant difference between male and female participants in terms of their familiarity with theatre; however, as individuals get older, their familiarity with the internet and virtual reality will be lower. Therefore, aged participants preferred simpler and more eligible environments.

The results of the present study illustrated that virtual scenery design, as a modern area that has its particular audiences, and is more suitable for the lower-aged population because the audience can consider the scene as real and will be afflicted with shock and any other relevant problems.

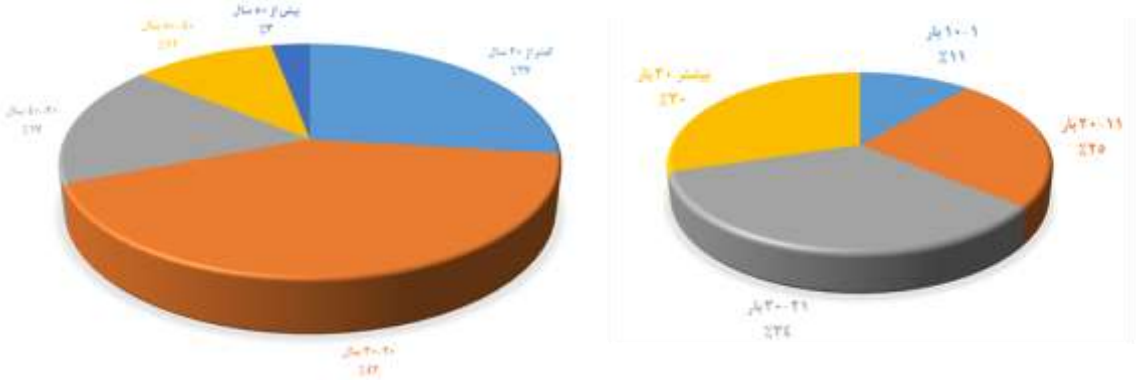

Fig 10 Distribution of the number of times individuals went to theatre concerning age variable

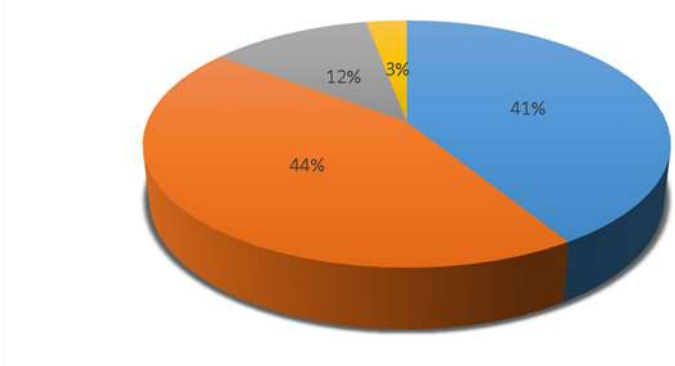

Fig 11 Distribution of participants' experiences in virtual reality theater

In this section, at first, the distribution of collected data must be identified, such that proper hypotheses and tests would be selected. To this end, the Kolmogorov-Smirnov test has been used. The formed hypotheses are as follows:

- H0= data distribution is normal
- H1=data distribution is not normal

Considering the above calculations regarding decision criteria, the values below 0.05 are significant and therefore the distributions are normal in a 0.95 confidence interval. Therefore,

considering the normality of data distribution as well as their measure which is continuous and interval, multiple linear regression and Pearson Correlation Coefficient tests are used to find out the relationships between dependent and independent variables, as well as the intensity and direction of such relation.

The following table (i.e. Table 2) displays the fit-related statistics including correlation coefficient, determination coefficient, moderated determination coefficient, and Errors' deviance. Considering the R-value of 0.928, one can argue that there's a strong correlation between study variables and there's no need to add another independent variable due to the possibility of predicting dependent variable through the same set of variables. Besides, the determination coefficient has been obtained as 0.861 which defines the variance explanation of the dependent variable. The moderated coefficient also states that all 10 variables obtained in this model seem to be appropriate for assessing the study's dependent variable.

Table 2 Summary of statistics for model fitness

Model	Z Kolmogorov-Smirnov	Determination coefficient	Moderated determination coefficient	Standard error of estimation
Study settings	0.928	0.861	0.833	0.23260

To define the model's significance variance analysis and F statistic is used. As it's evident from Table 3, the significance level of variance analysis is lower than 0.05; therefore, F is significant. Thus, independent variables enjoy a linear and independent combination of the dependent variable.

Table 3 Regression model's variance analysis

Significance level	F	Mean squares	Degree of freedom	Sum of squares	Model	
0.000	30.379	1.644	10	16.436	Regression	Scope of the study
		0.540	49	2.651	Residual	
			59	19.088	Total	

In this phase of the study, the Pearson Correlation Coefficient is used to study the relationship between independent variables through the data extracted from study participants. The correlation coefficient is a statistical instrument to find out the relationship between two variables and their intensity. The correlation coefficient displays both the direction of the relationship (either positive or negative) and its intensity (strong/weak). This coefficient is a number between (-1, 1) and equals zero in case there isn't any relationship between study variables.

Table 4 Correlation of independent variables

	A sense of timelessness	A sense of placelessness	Lighting quality	Color intensity	Sound	Environment fluidity	Variety of scenes	Imagination	Environment measures & decoration	Motion speed
A sense of timelessness	1									
A sense of placelessness	0.714	1								
Lighting quality	0.621	0.626	1							
Color intensity	0.412	0.453	0.421	1						
Sound	0.224	0.421	0.214	0.358	1					
Environment fluidity	0.625	0.568	0.721	0.325	**0.589	1				
Variety of scenes	0.306	0.215	0.210	0.112	0.545	0.056	1			

Imagination	0.307	0.112	0.214	0.245	0.216	0.215	*0.369	1		
Space measures & decoration	*0.605	0.118	0.245	**0.895	0.215	0.206	0.352	*0.568	1	
Motion speed	*0.152	0.214	0.157	0.278	0.235	*0.540	0.341	0.114	0.385	1

*P<0.05 and **P<0.01

The results displayed in Table 4 suggest that the highest correlation exists between a sense of placelessness and other components and after that, environment fluidity had the highest impact in improving that after other variables.

Table 5 Regression impact coefficients of independent variables on dependent variables

Significance level	**T**	Standardized coefficients		Non-standardized coefficients		Variable
		Hypothesis results	**Beta**	Standard error	**B**	
0.000	2.983	-	-	0.239	0.713	Constant value
0.000	4.562	yes	0.274	0.037	0.167	A sense of timelessness
0.000	3.761	yes	0.631	0.079	0.783	A sense of placelessness
0.000	7.395	yes	0.407	0.052	0.383	Lighting quality
0.002	0.048	yes	0.502	0.061	0.674	Color intensity
0.000	8.945	yes	0.317	0.029	0.374	Sound
0.000	9.480	yes	0.554	0.063	0.598	Environment fluidity
0.000	5.597	yes	0.436	0.072	0.493	Variety of scenes
0.002	1.948	yes	0.369	0.036	0.508	Imagination
0.000	2.983	yes	0.463	0.239	0.713	Space decoration
0.000	4.562	yes	0.274	0.037	0.167	Motion speed

The significance level and Pearson values for all variables displayed in Table 5 suggest that there's a significant correlation between independent and dependent variables. In other words, an increase in the independent variable will cause an increase in the dependent variable as well. Thus, it can be argued that H0 and H1 hypotheses will be confirmed and rejected respectively within 95% confidence interval.

"A sense of timelessness" variable with a beta coefficient of 0.63 has the highest impact in the virtualization of theatre scenery. In other words, a unit increase in a sense of timelessness variable will result in a 0.63 increase in the virtual theatre scenery variable. The second priority is specified to the independent variable of "environment fluidity' with a beta coefficient of 0.55 and the "color intensity" variable in the third place with a beta coefficient of 0.52 have the highest impact on virtual theatre's scenery. Besides, variables including "space decoration and measures" with a beta coefficient of 0.463, "variety in scenes" variable with a beta coefficient of 0.436, "lighting quality" with a beta coefficient of 0.407, "imagination" with a beta coefficient of 0.369, "Sound" with a beta coefficient of 0.317, "motion speed" with a beta coefficient of 0.274, populate 4th-10th priorities for virtualization of theatre scenery.

According to non-standardized regression coefficients of independent variables, the virtualization equation for theatre scenery are as follows:

+0.713 for Virtualization of theatre scenery (0.167) for a sense of timelessness+0.783for a sense of placelessness, +0.38 for lighting quality, +0.674 for color intensity, +0.374 for sound,+0.598 for environment fluidity, +0.493 for variety of scenes, +0.508 for imagination,0.541 for space decoration and measures +0.261 for motion speed.

7. Conclusion

Formal transformations of the art at the beginning of the century have taken place using materials higher than the scope of paint and canvas and it resulted in complete freedom of the artists from the constraints of previous contracts and made them move toward new media and facilities of artistic creation, especially, digital art. The combination of two distinct phenomena including performance arts and digital technology, with distinct growth paths, must be studied further.

Theatre artists are just like other artists and attempted to contain their mentalities and feelings in the form of a work of art. Theatre has shown that it always exploits its contemporary technology and is accompanied by modern aesthetical achievements besides wonderful technical facilities. Accordingly, all the stages involved in theatre production including the content of the play to pre-production stages including producing sound, music, and different sound qualities and the possibility of using video images in the scene, light adjustment, scenery decoration, costume design, and finally the possibility of using virtual actor (i.e. robot or motion capture) transformed theatre. Moreover, this digital option can provide different choices as well as regular planning for performance.

Whenever we use virtual reality, abstract theatrical principles including scenery (especially digital scenery design), lighting, and use of multimedia will be embodied and the audience can observe the whole set of director's thoughts and pictures, playwright, actors, etc. at once and therefore, all the activity domain of all theatre cast would be more extended concerning displaying abstract concepts, complex emotions, and metaphysical perceptions

It has been attempted in this study t study factors influencing scenery in virtual theatre and whether digital technology is better for performing arts or not. 151 questionnaires have been distributed randomly among study participants and as it has been noted, there isn’t any significant difference between male and female participants in terms of their familiarity with theatre. The older people get, they will be less familiar with the internet and virtual reality and therefore older participants prefer simpler and more eligible environments.

Then, a multivariate regression model has been used to study the factors and variables influencing the scenery of virtual theatre. The results showed that "a sense of timelessness" variable is the variable with the highest impact on the scenery of virtual theatre. The second and third priorities with the highest impact on virtual theatre scenery are occupied by environment fluidity and color intensity. Finally, variables including space decoration, variety of scenes, lighting quality, imagination, sound, motion speed, and a sense of placelessness occupy 4th-10th priorities concerning the virtualization of theatre scenery.

In case we'd be fully familiar with the impact of various factors on the scenery of virtual theater, we can increase mental and emotional embodiment in the form of an artifact. It has been found that the use of digital technology and virtual reality in the theater is a continuous process and the contemporary audience would welcome the particular technology of his/her own time; however, concerning limited resources and infrastructure within our country, the following recommendations are made:

1. Because theatrical performance is live, there must be a shared space with audiences in Iran's theatres.

2. There must be the possibility of installing digital facilities within theatres.

3. Performance includes limited stages and characteristics from the interaction and contrast between technology and computer.

4. The performance content including scenario, music, décor, and performance must be developed with the help of artists and solely to be performed for the audiences.

5. The performance must include one language and one text; such that scenario will make it progress toward the end and the scenario will be in distinction with dance, music, and other kinds of art.

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Typographic Expressions in Graphic Design Education

Touradj Fashandaki[a]*, Gülgün Alpan[b]

[a]*Islamic Azad University, Shabestar Branch, Department of Architecture and Art, Shabestar, Iran*
[b]*Gazi University, Faculty of Education, Department of Educational Sciences, Ankara 06500, Turkey*

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Abstract

In this manuscript, the reflection of typographic expression training methods such as integration, resolution, transposition, disintegration, and lettering on students' design and learning processes was strived to be analyzed. Qualitative and quantitative research methods were used altogether. The study group comprised of senior year Azad University Graphic and Architecture Faculty Visual Communication and Art students (10) who took the "Project Appliance" course. The group consists of volunteering students with elementary typography knowledge and typography skills who have not previously brought out creative, original, and new typography works. Students have designed posters as products before and after the training of typographic expression ways, respectively. Three experts graded the posters using a scoring rubric and answer key prepared by analysts. Evaluation results were analyzed with Wilcoxon Signed-Rank Test. A semi-structured interview was conducted after the training, and the data obtained were resolved by content analysis. By the research results, the products of students who have participated in the education of expression methods in typography were successful. Students have expressed to have progressed both professionally and personally. Themes such as creativity, feeling well, self-confidence, and satisfaction appeared in content analysis consisting of interview notes.

Keywords: Graphic Design Education; Graphic Design; Typographic Expressions; Typographic Training

* Corresponding author. Tel: +98-9122043089.
E-mail address: fashandaki@yahoo.com.

1. Introduction

Graphic design is a communication design. Graphic design transmits a message to the receiver with legible and visual two-dimensional images. Message design is usually used for advertising an industrial or an artistic product or a service. Sender convects cognitive and affective messages to the receiver (Ambrose & Harris, 2006; Becer, 1997; Bowers, 1999; Koren & Meckler, 2001; Landa, 2018). There are two fundamental elements in graphic design. The first is typographic elements, and the second is visual elements. Typographic elements include and transmit linguistic information and letters, numbers, and punctuation marks, while visual elements are photographs and illustrations. Typography is the exclusive art and technique of forming type to make language visible (Lau & Chu, 2015). Typography, the subject of this manuscript, is a reflection of language processed as form and shape. Typography is the art of designed lettering. Typography was critical in the graphic design of Latin, Chinese, Arabic, and Cyrillic alphabets. Obtaining an objective aesthetic level by conveying messages minimally through conceptual and typographic resolutions is contemporarily possible (Uçar, 2004). Typography has generally been included in contemporary arts. The artworks of contemporary artists who used fonts have been assessed by Kozlu and Benugur (2014).

Typography is defined as a condensed visual form of communication that conveys every thought and information to humankind through a visual impact (Carter, Meggs, and Day, 2011). The history of typography has begun with a printing technique consisting of changeable mobile letters founded by Gutenberg and continued with digital typography after modernism's developments. Graphic design education is the design of typographic elements as well as the design of visual elements. The subject of this manuscript consists of the education of graphic design students to strengthening typographic expression and being more creative. Literature surveying (Mesghali, 2011; Sarikavak, 2014; Skolos & Wedell, 2006; Tselentis, 2011; White, 2005; Willen & Strals, 2009) and the typographic expression ways determined and preferred by experts are integration, resolution, transposition, disintegration, and lettering. Integration is the union of font and image on the same layer. Resolution is the separation of the font from the visual elements in the background. Transposition is the conversion of the font to image and vice versa. Disintegration is the disjunction of font and image, and consolidation in a disconnected but mysterious sense. Lettering is the figural and aesthetic transformation of the typographical elements to decorative images. This study investigates the effect of instruction of typographic expression ways to students on the students' design and learning process.

1.1. Literature Review

The limited studies of typography in graphic design are as follows: In their studies, Lau & Chu (2015) investigated the method of using kinetic typography and interactive approach to conduct a design experiment for children to learn vocabularies. This study shows that through the implementation of motion graphics, kinetic typography, and information design, a more diversified learning experience can stimulate and strengthen children's perception sensitivity and learnability. It can also improve children's understanding of the meaning of vocabularies through kinetic expressions. Highsmith (2015) summarizes their view of typography training as a type designer in their article named The Typographic Collaboration: Is Type Design the Future of Typographic Education? Typography is a collaboration between the typographer and his or her chosen typeface. Though collaboration isn't new, the roles are changing. While learning typography takes less time each day, typefaces are getting more sophisticated and complex. The way a typographer works with

a typeface is evolving so type education should evolve as well. Loveless, Bhattacharya & Griffith (2012) have discussed the following: Typography is an affective re/presentational strategy when used as a medium within the research framework of arts-based inquiry. Grounded in a more extensive and comparative case study investigating the experiences of two elementary teachers, their study has situated typography within the field of arts-based inquiry, explored typography as a research process and product, examined the interpretive aspects of typography as representations of research data, and presented a rationale for the use of typography in educational studies. Researchers emphasize the importance of experiences and art interactions. According to them; Taking cues from street art and modernism's assault on status-quo assumptions, typography transforms normative research experiences to allow for a broader questioning of the way things are. The effects of creative typography practices in graphic design education on students' metacognitive skills and products through experimental design were investigated by Tarlakazan (2011) using a control group. It was found that the metacognitive skills of students who practiced creative typography were higher than the control group. However, no significant difference was detected between product grades before and after the experiment for each group. Uslu (2009) evaluated the typography lectures given in higher education institutions. Uslu observed both the students and the instructors mostly agree that students don't receive sufficient education on typography enough to satisfy market expectations. Additionally, students were noticed to be keener on digital typography courses. Dündar (2005) researched typographic language in graphic design in the West and Turkey. Dündar found that in the West, typographic language tended to "imagination" concordantly to new technologies and the thus changing structure of reading, when in Turkey, despite not dating back far, typographic language in graphic design was seen to progress especially simultaneous to increasing opportunities of communication. Relevant investigations showed limited studies were conducted on typographic expressions in graphic design. This manuscript is expected to contribute to the literature.

2. Research Method

In this study, qualitative and quantitative research methods were used altogether. Quantitative data was obtained through the evaluation of single-grouped experimental design method products whereas qualitative data was collected through semi-structured interviews with experimental design method participants.

2.1. Study Group

The study group comprised of senior year Azad University Graphic and Architecture Faculty Visual Communication and Art students (10) who took the "Project Appliance" course. The group consists of volunteering students with elementary typography knowledge and typography skills who have not previously brought out creative, original, and new typography works. Students' ages range between 21 and 25. Four of them were female and six of them were male.

2.2. Data Collection Tools

An experimental method was employed in this study. The research's model is a single group pretest-posttest design. The experimental process of the research is typographic expression method training and applications. Before and after practical training, student products (poster design) were collected. For the evaluation of these products, researchers developed a scoring rubric and an answer key scale based on fundamental elements of typography and graphic design. For every

typographic expression method (integration, resolution, transposition, disintegration, and lettering) each student was asked of two products for pre and post appliance. The scoring rubric and answer key scale were formed as a total of 29 items for the products of five typographic methods. On the scale, each observed feature of a product was determined separately. In this manuscript, only the criterion of the first method (Integration - Time) for the first asked poster is given as an example. (1) Providing the spatial relation between font and image. (2) Providing the form relation between font and image. (3) Providing the motion unity between font and image. (4) Conveying the message efficiently with font and image altogether. (5) Ensuring legibility. (6) Integrating the other elements (color, texture, line, point, etc.) with the design. (7) Creativity and originality of the design. The Rubric scale regarding the products is as follows: excellent: 4, above satisfactory: 3, satisfactory: 2, below satisfactory: 1, not satisfactory: 0

To collect the qualitative data of the study, the semi-structured interview forms were prepared and used to collect student views on the experimental process. The following open-ended questions were asked to the students to determine the contributions of the training of typographic expression methods in graphic design to their work and progress: (1) What are your thoughts on the training of typographic expression methods you have received? (2) You have been taught about typography and image relation under five methods. What are your thoughts on these methods? (3) What are the contributions of your experiences during the course to you?

The draft interview form was consulted with experts for validity-check and regulated as advised.

2.3. Data Collection and Research Application Process

Prior to the research application process, necessary permits were obtained from the director of the concerning graduate school. The research application process lasted 8 weeks. The first author of this manuscript who teaches typography and graphic atelier courses in Iran at Azad University Art and Architecture Faculty has trained the students himself during this process. Before the pre appliance, the students were informed about the study, the procedures, and were given the names of five typography methods and students were asked to design a poster (product) solely using their own experiences for each typography method. The designs were made with Photoshop and Adobe Illustrator. For each poster, the chosen subjects are as follows: 1. Time, 2. Music, 3. Theatre, 4. Speed, 5. Peace. The works and the choices of the students were not intervened. The products were saved to computers in JPG format.

During the research application process, a presentation on typographic expression methods in graphic design was made, and additionally, a Q&A session with discussion was held. The sessions were enriched by discussions on national and international example studies. Poster drafts were evaluated in the atelier cooperatively with the students. In the last two weeks, the students were asked to think about the posters they have made before the pre-appliance and re-design the posters with what they have learned during the training. The students were again not intervened. Poster subjects regarding the pre and post appliances and the typographic expressions are depicted in Table 1. At the end of the training, the products of students were printed and preserved to be evaluated.

Table 1 Research Application Process

Typographic Expressions	**First poster**	**Last poster**
Integration	1. Time	6. Time
Resolution	2. Music	7. Music
Transposition	3. Theatre	8. Theatre
Disintegration	4. Speed	9. Speed
Lettering	5. Peace	10. Peace

To collect the qualitative data of the study, semi-structured interviews were conducted with the students individually. The interviews lasted about 20 to 30 minutes. The interviews were audio-recorded and detailed notes were taken.

2.4. Data Analysis

The posters designed before and after the pre and post appliances, respectively, were evaluated by three field academic experts with the scoring rubric and answer key and the results were tabulated. The study was conducted with a group of 10 students therefore the results of pre and post appliances were acquired by a non-parametric test, Wilcoxon Signed-Rank Test.

In the qualitative part of the study, the data collected by semi-structured interviews were analyzed by content analysis. The audio recordings were converted into written documents. Written documents were compared with the researcher's notes, and coding and thematic coding were done by two researchers. For the reliability of the data, the formula [Consensus / (Consensus + Disagreement)] x 100, which was proposed by Miles and Huberman (1994), was used and the percentage of agreement was calculated as 0.80. Direct quotations were included to reflect the views of the participants more realistically and to ensure the validity of the research. Participants were given the nicknames S1, S2, etc. Additionally, qualitative analysis results were digitized and presented in tables for ease of reading.

3. Findings

In this manuscript, the reflection of typographic expression training methods on students' design and learning processes was analyzed. In this regard, the total score average of students' products before and after the training is depicted in Table 2.

Table 2 Total score average of pre and post appliance products

Typographic Expressions	**First poster**	**Last poster**
Integration-Time	1.7	3.59
Resolution-Music	1.98	3.66
Transposition-Theatre	1.83	3.60
Disintegration-Speed	1.83	3.58
Lettering-Peace	1.82	3.61

Table 2 shows that the total average scores of post appliances products were higher than of pre appliance products. Wilcoxon Signed-Rank Test was used to determine if the difference between total average grades were significant. The results are laid out in Table 3, 4, 5, 6, and 7, respectively.

Table 3 Wilcoxon Signed-Rank Test Results of pre and post appliance scores for Integration-Time posters

Pre & Post Appl.	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-4.809	.000
Positive Ranks	30	15.50	465		
Ties	0	-	-		

Table 4 Wilcoxon Signed-Rank Test Results of pre and post appliance scores for Resolution-Music posters

Pre & Post Appl.	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-4.823	.000
Positive Ranks	30	15.50	465		
Ties	0	-	-		

Table 5 Wilcoxon Signed-Rank Test Results of pre and post appliance scores for Transposition-Theatre posters

Pre & Post Appl.	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-4.797	.000
Positive Ranks	30	15.50	465		
Ties	0	-	-		

Table 6 Wilcoxon Signed-Rank Test Results of pre and post appliance scores for Disintegration-Speed posters

Pre & Post Appl.	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-4.805	.000
Positive Ranks	30	15.50	465		
Ties	0	-	-		

Table 7 Wilcoxon Signed-Rank Test Results of pre and post appliance scores for Lettering-Peace posters

Pre & Post Appl.	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0	.00	.00	-4.800	.000
Positive Ranks	30	15.50	465		
Ties	0	-	-		

Table 3, 4,5,6, and 7 show a significant difference between pre and post appliances in categories Integration-Time, Resolution-Music, Transposition-Theatre, Disintegration-Speed, and Lettering-Peace that is in favor of post appliance products. These findings show that typographic expression method training has a positive effect on student products and is efficient. The qualitative data obtained from post-application student interviews support the quantitative data.

Figure 1, depicts the rates of common thoughts of students and the themes acquired through the content analysis of semi-structured interviews that were conducted after the typographic expression methods training.

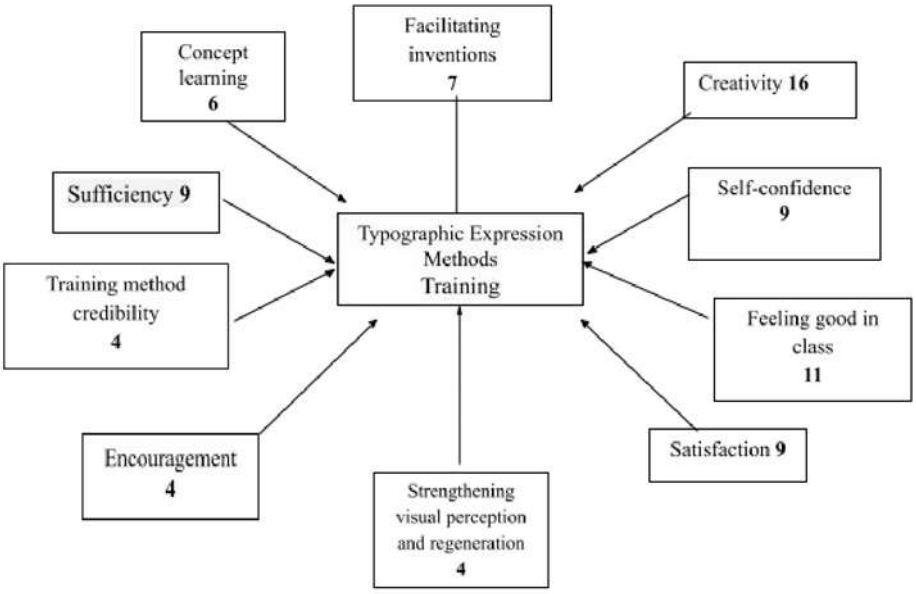

Fig 1 (a) Students' views after typographic expression methods training

Figure 1 shows that students' views of typographic expression methods training include the following themes: creativity (16), feeling good in class (11), self-confidence (9), satisfaction (9), sufficiency (9), facilitating inventions (7), concept learning (6), encouragement (4), training method credibility (4), strengthening visual perception and regeneration (4)

Some quotations of students' thoughts are given below:

"...I can say that your teachings were very meaningful and convincing. Compared to before, I pay better attention to composition and typographic expression in my work. I have discovered my creativity. Now my thoughts can become designs". S 5

"...we have proceeded from theory to practice in class, so I have understood the subject better. I have designed my thoughts... I feel good. I have learned the practicing field of typography. Now I see a creative power in me." S 8

"I have never felt this satisfied and confident. This training and what I have learned has given me strength and increased my creativity. I've learned what font is. With the things I've learned, I can now say that I exist in the world of design." S 4

"We've worked on five methods about typography and image. I can say that all of them were very meaningful to me. I can explain which design belongs in which method easily. Better yet, I've understood the importance and use of typography better. I've gained creativity and self-confidence." S 6

"It's safe to say this training has been very useful. I now have learned the function and concept of typography. My horizons are broadened, I have thought deeper and felt more productive." S 3

The quotations from students show that typographic expression methods training has contributed to students both professionally and personally.

4. Discussion and Conclusions

In this manuscript, the reflection of typographic expression methods training on students' design and learning processes was analyzed. In this regard, students are found successful based on the evaluation of their products before and after the typographic expression methods training. Students have reflected to have developed both professionally and personally. Themes such as creativity, feeling well, self-confidence, and satisfaction appeared in content analysis consisting of interview notes.

Tarlakazan (2011) found that students in the experimental group who have taken creative typography practice training have higher metacognitive skills compared to those in the control group who have taken traditional typography training. In this research as well, students have designed successful products along with feeling more creative and regenerated due to newly learned concepts. These results coincide with the results of studies that emphasize the importance of experimental projects in typography courses in graphic design education (Ayrancı, 2009; Benugur, 2012; Uslu, 2009; Yücebaş 2006). In their manuscripts, Loveless, Bhattacharya & Griffith (2012) and Lau & Chu (2015), have pointed out the use of typography in educational studies. This study too is a graphic design and typography study which is thought to fill a significant gap in the field. In the light of this discussion, experimental and creative typographic expressions are advised to be included in all graphic design training programs and applications.

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Effective Parameters on Post-Disaster Temporary Housing Design in Rural Settlements

Farzaneh Hadafi[a], Alireza Fallahi[b]*, Seyed Gholamreza Islami[c]

[a]*Ph.D. in Architecture, Department of Architecture, Science and Research Branch,* ***Islamic Azad University****, Tehran, Iran*
[b]*Professor of Disaster Studies and Reconstruction Department, Faculty of Architecture and Urban Planning,Shahid Beheshti University, Tehran, Iran*
[c]*Professor of Architecture, School of Architecture, College of Fine Arts,* ***University of Tehran****, Tehran, Iran*

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Abstract

Provision of temporary housing for victims and survivors of a disaster is one of the most important issues in disaster management process. The purpose of this study was to identify the parameters affecting the post-disaster temporary housing design in rural settlements by reviewing the theoretical literature over previous experiences. Based on the findings, the effective parameters were: "Standards of dimensions and housing size with a minimum occupancy level"; "Durability and useful life of the proposed structure and details"; "Optimal construction costs such as components and materials"; "Structural strength"; "Ease of production and possibility of using prefabricated constructs"; "Possibility of building using vernacular-local details"; "Ease of transferability (size and weight)"; "Possibility of storage and maintenance in minimum space"; "Multiple applications and reusability"; "Simplicity and ease of installation, establishment, assembly, and repair"; "Familiarity of the local-vernacular people with the applied structural form"; " Possibility of using local-vernacular people in establishing the settlement"; "Adaptation to the local, social, and cultural characteristics of the context (providing a private environment)"; "Taking into account the physical condition and needs of special people (children, women, and injured people)"; "Flexibility in arrangement and location in different geological and environmental situations"; "Flexibility in lay-out and arrangement in indoor spaces according to the users' needs"; "Possibility of using local people to build and set up"; "Applying safety tips"; "Providing thermal comfort"; "Energy consumption"; and "Adaptation to the micro-climate conditions of the region".

* Corresponding author. Tel: +21-29902864.
E-mail address: alireza.fallahi@outlook.com.

This paper was extracted from the Ph.D. thesis of the first author, supervised by the second author, and advised by the third author. The thesis was entitled: Design Principles of Temporary Shelters after Earthquakes.

The findings of this study can be considered by experts, planners, and policy makers in the field of architectural design and temporary housing.

Keywords: Temporary Housing; Rural Settlement; Architectural Design; Crisis Management; Earthquake

1. Introduction

Natural disasters include unforeseen events that occur as a result of natural processes such as earthquakes, floods, glaciers, tornadoes, volcanoes, and droughts (Lahmian and Gholami, 2019). Among the natural hazards, numerous earthquakes occur in Iran, which is due to the location of Iranian plateau on the seismic belt of the Alpine-Himalayas and existence of numerous faults in this region. This indicates that this region is tectonically active and shows emergence of irreparable damages, especially in rural settlements (Nourizadeh et al., 2020; Zaheri et al., 2015). The frequency of destructive and catastrophic earthquakes in recent decades show that a strong earthquake occurs in Iran every four years on average, resulting in destruction of 97% of the rural units in the earthquake zone (Badri et al., 2019). Statistics of destructive earthquakes in the country show that rural buildings are highly vulnerable, so that not only severe earthquakes, but also weak earthquakes have a devastating effect on them (Golabchi and Taybat, 2007: 32).

Extensive earthquake damages to the environment and body of human settlements have turned temporary settlements to an important field of study in the realm of crisis management. Given that temporary housing of earthquake victims is highly essential (Jamalabadi et al., 2019), provision of temporary housing is one of the most important issues in the crisis management process (Fallahi et al., 2016). Therefore, one of the most important challenges in post-earthquake crisis management is temporary settlement of the victims (Bahadori et al., 2017). Post-earthquake temporary settlement has been studied for more than five decades in the world, but the conducted research mainly focused on the study of technical issues by related organizations and thinkers in this field (Félix, et al ., 2013; Narooyi and Aghaeizadeh, 2017).

The types of temporary housing vary from country to country according to various factors, such as the type of natural disasters, environmental conditions, and economic factors (Hong, 2017).

The global need for temporary housing is expected to increase due to the following factors: increased severity of natural disasters that result in a large number of displaced people; increased number of climate refugees as a result of the change in climate; and inability of developing countries to provide sufficient infrastructure in pace with their rapid population growth (Perrucci, et al., 2016).

One of the basic needs of victims of natural disasters is planning for their temporary settlement, which plays a decisive role in preserving and saving human lives and providing security in the early stages after an accident (Khorshidiyan, 2010). According to the accident literature, the purpose of temporary housing is to choose a suitable place and plan to create a healthy, safe, and relatively comfortable living space that meets the basic individual, family, and social needs. In general terms, temporary settlement is more than a four-walled house; in other words, it includes livelihood, cultural, and psychological dimensions (Fallahi, 2007).

Temporary settlement was studied comprehensively, not only as a physical product, but also as a process, ranging from emergency sheltering to permanent sheltering in various contexts (Fallahi, 2007). Despite the performed efforts, the existing experiences show that no significant progress has been made in providing temporary settlement or in particular, post-disaster settlement. Various

methods were employed of providing temporary settlement for victims of the recent natural disasters in Iran, but they were not effective in practice due to their lack of compliance with conditions of the disaster area. On the one hand, these solutions caused long-term problems and difficulties in the disaster area and on the other hand, they were a waste of financial resources (Khorshidiyan, 2010). The type, severity, and location of the disaster, conditions of the local community, ability of the community to cope with the accident, amount of damages and casualties, as well as local methods of housing and construction prior to the accident affect the type of settlement and housing (Fallahi and Zenian, 2017). Temporary settlement plays an important role in repairing the interrupted process of normal life in the field of economic and collective activities in the affected areas (Khorshidiyan, 2010). Temporary housing facilities, often referred to as shelters by authorities should provide: (1) protection from environmental hazards and harmful factors; (2) maintenance of properties and assets; as well as (3) privacy and emotional security (Barakat, 2003; Félix, et al., 2013; Jamalabadi et al., 2019; Li et al., 2017). Observance of gender considerations in programs reduces women's vulnerability during the crisis with regard to temporary housing. Consequently, the entire crisis-stricken society can use positive results of such programs (Saedi Khameneh and Hosseini, 2010). Settlement should provide the families with security, comfort, and a sense of belonging. So, in providing shelter for the injured, special attention should be paid to restoring their status and dignity (Fallahi, 2007).

The main problem is that in most cases, temporary housing is considered as a shaky, unstable, cheap, and perishable building. The plans proposed by the shelter designers failed since they presented their plans far away from the accident scene, without an appropriate understanding of the victims' basic needs, and with little awareness about the victims' the special social, cultural, economic, and livelihood needs (Fayazi and Alizamani, 2012). In this regard, one of the shortcomings is lack of an in-depth view towards the temporary housing phase by managers and executives in the field of crisis management. Since authorities consider temporary housing as a mere transitional stage, they do not take appropriate measures according to the victims' conditions and many weaknesses occur over time consequently (Hadafi and Fallahi, 2010; Hadafi et al., 2020). Therefore, our main question in this study was: What are the effective parameters in designing post-traumatic temporary housing in rural settlements?

2. Literature Review

Recent research addressed the criteria for designing temporary housing in various ways.

Sener and Alton (2009) examined the indicators of evaluating and designing temporary housing such as construction technology and materials, building structure, cost, aesthetics, ecology, spatial organization, and sociology (Sener and Alton, 2009).

Mottaki et al. (2019) studied the design pattern of temporary housing after a possible earthquake in Qom and listed the principles of temporary housing design as: public participation, cost, labor, users' needs of space and privacy, transportation, manufacture technology, materials, durability, aesthetics, characteristics of the affected population, storage, thermal comfort, duration of construction, and moisture resistance (Motaki et al., 2020).

Bemanian and Bakhtiari (2014) compared the capacities of the lightweight steel structures (LSF) system with the ICF for temporary housing in post-earthquake crisis conditions and reported the following features: high construction speed; low weight; low volume in pre-setup mode; easy storage conditions in warehouse; easy portability; low number of connections; simple implementation requiring little technical skill; possibility of expansion in the future; manageable

and implementable in various areas; prefabricated production; construction with available materials; and replaceability of parts (Bemanian and Bakhtirain, 2014).

Khorram et al. (2015) investigated temporary housing design criteria in earthquake (a case study of Khorasan Razavi) through a user-centered approach by assessing the users' needs. They noted the following characteristics in designing temporary housing: fast construction; easy connections; possibility to divide spaces with a modular design for different sizes of households; provision of restroom; appropriate materials; easy access to equipment using portable elements inside the settlement; provision of thermal comfort; consideration of microclimate, human dimensions, people with disabilities; maximum use of space; and low production cost (Khorram et al., 2015).

Tayarani Najjaran and Khorram (2016) designed a modular temporary shelter based on user-centered approach for survivors of natural disasters (earthquake). They reported the following criteria in designing temporary housing: comprehensible form and structure for the local people; rapid construction; production costs; uniform and mechanized connections; ease of construction; maximum use of interior space; consideration of local micro-climate; ability to divide and increase the space for minimum and maximum households; application of insulating materials suitable for temperature changes; consideration of the required facilities for each household to live (hypothetically) for one year; provision of private security; and attention to people with disabilities (Tayarani Najjaran and Khorram, 2016).

Seyed Sharafi and Hatami (2015) evaluated the feasibility of using LSF in temporary housing in the affected areas. These researchers introduced the features of a temporary settlement as the following: prefabricated production; easy maintenance and storage; social and cultural acceptability; implementable by the local people with low technical skills using the guides; ease of transfer; durability of materials; adaptation to weather conditions; thermal comfort; reusability; and provision of the required necessities to continue livelihood activities (Seyed Sharafi and Hatami, 2015).

Forghani and Darbandi (2015) addressed some important points in building temporary housing: providing quick access for the victims; using local resources and forces; paying attention to local living standards; being usable during the required length of time for temporary housing; having the possibility to relocate settlements and their parts after the end of temporary housing period; and being environmentally friendly (Forghani and Darbandi, 2015).

Fallahi (2007) noted that the designed temporary housing should be: easily portable; protective of residents against climate / weather conditions; established easily by local people and victims; made by high-quality and durable materials; constructed by recyclable materials; private and protective of residents; responsive to various activities and functions; expandable; and economic (Fallahi, 2007).

Lindell et al. (2007) investigated the physical and structural characteristics of temporary housing and reported the following features: low weight and volume in storage; high speed in construction; easy to set up; low number and variety of connections; expandability in the future; possibility of replacing and changing parts; as well as application of prefabricated and simple connections (Lindell et al., 2007).

Bahrainy and Akhoundi (2000) listed the characteristics of temporary settlements from the victims' viewpoints: protecting victims from heat, cold, wind, and rain; storing and preserving furniture; establishing and maintaining the house boundaries (ownership and right of possession); providing psychological security and private environment; providing access to the workplace (Bahrainy and Akhoundi,2000).

Sartipipour (2011) presented the idea of architecture with paper materials for designing and implementing temporary housing. Their features included: protection of residents from the changing conditions of the natural environment such as heat, cold, wind; fast portability and start-up; applicability in different situations; use of appropriate structures; ease of production; ease of installation and simple execution details; as well as harmonization with the environment and climate (Sartipipour, 2011).

Asefi and Farrokhi (2018) introduced the indicators of temporary housing evaluation as: provision of security; preservation of human dignity and privacy; easy participation; environmental perception; appropriate body and form; consideration of health issues; provision of justice; architecture and design; facilities and energy; easy maintenance, installation, and establishment; consideration of technical and structural standards; as well as application of vernacular resources (Asefi and Farrokhi, 2018).

Johnson (2007) also examined the components of temporary housing and reported that they should: have low price and fast construction; provide easy and non-polluting removal; and be in line with the victims' culture; reusable; and in compliance with the standards (Johnson, 2007).

Momeni and Zeinali (2018) proposed constructing temporary housing by palm tree branches in accordance with the characteristics of Balochistan landscape. The mentioned features were: use of available materials; establishment by the local people and women; cheap price; establishment with no cost; adaptation to the climatic conditions of the region; high speed of establishment; possibility to establish in less than a week; establishment in specific dimensions and sizes; establishment in various sizes; application of vernacular materials; reusability in establishment of permanent houses; familiar with people; current application in everyday life of local people; environment friendly; portability; respect for the family privacy; possibility of cooking; possibility of residence; maintenance of agricultural products; applicability as warehouse for storage of equipment; lightweight structure; and possibility of improving its durability by suitable materials (Momeni and Zeinali, 2018).

Nikravanfard (2007) referred to the criteria for designing temporary housing and mentioned the following factors: having a special identity in terms of general, technical, and functional characteristics; considering different areas tailored to the needs of users; using prefabricated, light-weight, durable, and stable constructs; using the existing and vernacular materials; being established easily by people with low skills and women; and considering the factors affecting thermal comfort.

A review of literature shows that studies conducted in this area investigated the dimensions of temporary housing in rural or urban areas in details. However, no study has ever identified and introduced the effective parameters in designing post-traumatic temporary housing in rural settlements comprehensively. Accordingly, this research reviewed and analyzed previous studies to identify and introduce these parameters. In this regard, we searched the valid scientific databases to identify the related sources of information. Later, these sources were screened in accordance with the study objectives and finally, effective parameters were extracted and introduced for designing temporary housing.

3. Theoretical Concepts

3.1. Temporary Housing

Housing is one of the basic human needs. Given that permanent settlements are damaged followed by accidents and natural disasters and construction of settlements for the victims requires

a lot of time and money, the issue of temporary housing is of great importance (Givechi et al., 2013). Temporary settlements are necessary when the victims of an accident are not able to return to their houses; i.e., where they lived before the accident (AbdulAlipour, 2017). Temporary housing is defined as providing a shelter according to the victims' basic needs, living needs, and psychological comfort in order to maintain their human dignity within the family and social system in difficult circumstances (Fallahi, 2007). The duration of temporary settlement may vary from a few days to two years, depending on the circumstances, the type of crisis, and the required facilities (Forghani and Darbandi, 2015). Findings show that features such as low cost, appropriateness to climatic conditions of the region, application of vernacular materials, and victims' participation affect desirability of the temporary housing process (AbdulAlipour, 2017). Depending on the extent of the accident, climatic conditions, and duration of reconstruction, temporary housing can be observed as a step in the reconstruction process (Bashiri and Bemanian, 2020).

In order to provide the necessary facilities and the possibility of designing apropriate settlements in the temporary housing phase, case studies conducted over temporary housing should be investigated. The aim is to obtain the necessary characteristics, strengths and weaknesses, as well as application of these settlements in new designs (Asefi and Farokhi, 2016). Experiences of previous earthquakes in Iran indicated a lack of a comprehensive housing program based on the spatial capacities of the affected community (Danaeinia and Zaghiyan, 2019). In a study, the main tasks of temporary housing was determined from the viewpoints of victims or those who experienced accidents: protecting against heat, cold, wind, and rain; storing furniture and preserving what survived the disaster; establishing and maintaining the boundaries of the house (ownership and right of possession); creating initial conditions for the next operations (transferring the properties, reconstruction of the building, as well as reorganization of the social organization); creating psychological security and private security; determining a specific address for receiving services (medical services, food); accommodating people where they can have access their work environment; and providing housing for families who evacuated their homes due to the fear of further accident damages (Omidvar et al.,2007; Bahrainy and Akhoundi,2000). However, we should acknowledge that temporary housing is not a fixed or identical issue and is fraught with differences.

Some believe that temporary housing is the interface between emergency sheltering and permanent reconstruction. In this vein, temporary housing is considered as a connection chain between initial stages of accident management and permanent reconstruction. Proponents of this idea do not consider the nature of temporary housing as a separate stage. Some other people believe that temporary housing is a separate stage that should be considered separately. In this regard, temporary housing plays a vital role after an accident and should be improved as a system in itself and as a part of a larger system to deal with the accidents. On the one hand, temporary housing provides reconstruction planners and managers with the opportunity to make decisions and plans more easily and effectively. On the other hand, it ensures the people's safety in temporary housing. Based on the Article 25 of the Universal Declaration of Human Rights, adequate housing is the right of everyone. With the occurrence of destructive natural disasters and in post-traumatic crisis situations, the society functions and social institutions are disrupted in a certain period of time. Moreover, the victims are deprived of the right of proper housing. Due to the prolonged construction of housing, this right should be preserved for the victims in terms of temporary housing (Asefi and Farrokhi, 2016; Omidvar et al., 2007; Mohammadzadeh and Farrokhi, 2016; Johnson, 2007).

3.2. Temporary Housing Design Approaches

The three main approaches to temporary housing design are: "design-based" and considering technical aspects; "material-based"; and "public-based", which are described in the following (Fayazi and Alizamani, 2012; Fallahi, 2007; Motaki et al., 2020):

"Design-based" approach mainly focuses on technical aspects of housing. For example, the methods of designing and building a unit at the scene of an accident or in the factory and moving it to the accident area are among the issues of interest. Temporary houses in this approach constitute a wide range of pre-fabricated and post-fabricated items that are very diverse in terms of materials including tents, foam and polyurethane, concrete, wood, sandwich panels, and metal. In a special project by the United Nations Development Program for the structural aspects of temporary housing, this approach was divided into physical categories of "unit", "tent", and "plate".

"Materials-based": the main focus of this approach is on temporary housing. In recent years, much attention was paid to the type of building materials in constructing temporary settlements. In this regard, the emphasis is on applying local materials and recycling. However, discrepancies exist considering the advantages and disadvantages of using these materials in the long run as well as their effects on the natural ecology in the developing and developed countries.

"Public-based" approach takes into account people's satisfaction with the evaluation of temporary and permanent housing in terms of functionality and architecture. Moreover, the changes made over time by the household to turn this temporary settlement into a home are another available approach in the literature with regard to disasters. Although the nature of this approach is different from the two previous approaches, the criteria of changes made in similar previous disasters with regard to temporary housing are the basis for its application in the subsequent accidents.

3.3. Temporary Housing in Terms of Layout

Different views exist on the layout of temporary housing, which can be investigated under three approaches (Sabt et al., 2006; Fayazi and Alizamani, 2012; Hadafi et al., 2020; Hadafi, 2013; Sajedi et al., 2018):

Scattered approach: In this method, affected people are provided with temporary settlements based on some considerations, so that they can install these settlements in any suitable situation as they prefer according to their desire.

Integrated or camp approach: Although this approach is considered as the most common and perhaps the simplest method in setting up temporary settlements after accidents, it is simultaneously faced with the most environmental, economic, social, and security problems. In fact, area near the accident site is leveled and prepared for setting up tents and prefabricated structures as temporary housing for the injured. In this method, factors such as demographic conditions, duration of residence, climatic conditions, available resources, and accessible budget are considered in making decisions about implementation of the camp. Davis studied shelter after the accidents and found that survivors of disasters preferred to set up temporary settlements near their destroyed house. Examples of this method can be observed after Rudbar earthquake in 1990 and Bam earthquake in 2003.

Combined approach: In this method, we assume that survivors of the accident are aware of their temporary housing based on a specific plan. In this method, temporary housing is located next to the survivors' house, so that they can be near their destroyed house and use the facilities of life as a whole.

3.4. Types of Post-Crisis Housing

Different categories were presented based on various aspects with regard to the post-crisis settlement stages. For example, Quarantelli (1982) proposed four distinct types of post-crisis housing based on the case study documents from three different areas at the US Crisis Research Center. The typology included:

- Emergency sheltering: refers to a type of settlement in which survivors choose a place near their permanent residence for a short period of time; i.e. from a few hours to a maximum of one night;
- Temporary sheltering: is defined as a type of housing that survivors choose to reside temporarily for a short time based on their expectations;
- Temporary housing: does not easily meet the expected minimum of housing, but can still meet the daily activities and responsibilities of households;
- Permanent housing: causes the survivors to return to renovated or new homes and provides permanent housing for victims (Quarantelli, 1995).

Generally, emergency, temporary, and permanent housing stages were experienced in the post-crisis literature, which are explained in the following (Mosayebzadeh et al., 2017; Sajedi et al., 2018; Jasmpour, 2012: 12; Saedi Khameneh and Hosseini, 2010; Nigg, et al., 2006: 120; Bolin, 1993; Lindell, 2013; Behzadfar, 2005: 27):

Emergency housing: Immediately after the crisis, the need is felt for rapid settlement of the victims. This type of housing is established to protect survivors and victims from the bad weather conditions such as heat, wind, and rain. Settlement in this phase does not have high standards and the means of settlement usually include tents and vernacular materials. The duration of settlement at this stage is less than one month and may be less than 72 hours depending on the type of crisis.

Temporary housing: Few days after the crisis and prior to the provision of permanent housing, the living standards are low in the emergency housing phase. So, temporary housing tries to improve the living conditions of victims. In this type of housing, all necessary measures are taken, including collection and identification of distressed and homeless victims, transfer of people to housing centers, and creation of safe and healthy living conditions until they can return to their original places of residence. The duration of temporary housing may last from six months to two years, depending on the circumstances, type of crisis, and required facilities.

Permanent housing: At this stage, permanent settlements are provided for the people, so that they can return to their normal and daily life.

In Iran, a lot of discrepancies exist regarding the existence or non-existence of temporary housing as an intermediate stage between emergency housing and permanent housing (Momeni mokoee and Zeinali, 2018). In fact, the concept of temporary housing is a combination of the three types of housing mentioned above, since it includes both physical and non-physical aspects of post-traumatic shelter and residence. Therefore, temporary housing can be considered as a set of activities, including collecting and identifying the distressed and homeless victims, transferring people to a housing center, and creating living conditions until they can return to their original houses. The duration of temporary housing can range from 6 months to 2 years depending on the conditions, the type of crisis, and the required facilities. Some researchers and relief organizations consider this type of housing as the core of permanent housing (Hadafi, 2013; Fallahi, 2007).

4. Results and Suggestions

The aim of this study was to identify the effective parameters in designing temporary housing in the rural settlements and to explain a comprehensive structure for evaluating these settlements. Examination of the theoretical and experimental literature in the field of evaluating and designing temporary housing indicated that it is a multidimensional problem based on temporal and spatial situations. Based on the findings of this study, 21 effective parameters were found in designing temporary housing in rural areas: Standards of dimensions and housing size with a minimum occupancy level, such as a modular spaces; Durability and useful life of the proposed structures and details; Optimal construction costs such as components and materials; Structural strength; Ease of production and possibility of using prefabricated constructs; Possibility of building using local-vernacular details; Ease of transferability (size and weight); Possibility of storage and maintenance in minimum space; Multiple applications and reusability; Simplicity and ease of installation, establishment, assembly, and repair; Familiarity of the local-vernacular people with the applied structural form; Possibility of using local-vernacular people in establishing the settlement; Adaptation to the social and cultural characteristics of the context (providing a private environment); Considering the physical condition and needs of special people (children, women, and people with disabilities); Flexibility in arrangement and location in different geological and environmental situations; Flexibility in lay-out and arrangement in indoor spaces according to the needs of users; Possibility of using local people to build and set up; Applying safety tips; Providing thermal comfort; Energy consumption; and Adaptation to the micro-climatic conditions of the region. Since temporary housing is a multifaceted and complex process that requires comprehensive and dynamic attention, the following suggestions are proposed in line with these two approaches:

- Codifying experiences of the affected villagers with regard to living in the temporary housing phase;
- Presenting descriptive reports on the nature and differences of temporary housing in rural settlements with urban settlements;
- Developing specific instructions and standards for designing and constructing temporary housing units in rural areas;
- Developing temporary housing programs based on spatial capacities according to previous experiences;
- Explaining intervention methods based on technical and social dimensions;
- Holding competitions for designing temporary rural housing in order to produce and expand conceptual ideas with collaboration of architectural and industrial designers;
- Providing the ground for interaction and cooperation of architectural, landscape, industrial, and environmental designers with manufacturers and builders of units by trustees and decision makers regarding the design of temporary housing based on the needs.

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Effect of Seismic Horizontal Loads on the Structure of the Taj al-Molk Dome in Jameh Mosque of Isfahan

Alireza Ashrafi[a], Reza Abouei[b]*, Mohammad Mehdi Karimnejad[c]

[a]*M.A. Student, Department of Art and Architecture, Yazd Branch, Islamic Azad University, Yazd, Iran*
[b]*Associate Professor, Department of Art and Architecture, Yazd Branch, Islamic Azad University, Yazd, Iran*
[c]*Assisstant Professor, Department of Art and Architecture, Yazd Branch, Islamic Azad University, Yazd, Iran*

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Abstract

The external forces acting on the structures are divided into two categories based on the direction of application: a. Loads applied in the vertical direction or gravity loads such as: dead loads, live loads, snow load, etc. b. Loads applied in the horizontal direction or lateral loads such as: earthquake load, wind load, etc. Therefore, in this study, the behavior of the northern dome of Isfahan Jameh Mosque (Taj al-Molk dome) was examined under horizontal seismic loads using a finite element three-dimensional model (3D FE) (nonlinear dynamic analysis) with one level of numerical complexity with the aim to cover the structure of the dome, which has a medium to high complexity in operation. The results indicated that the structure of the Taj al-Molk dome is vulnerable to horizontal loads, so that if the residual deformation occurs in the range of 0.4% and 0.8%, it will cause the structure to collapse. On the other hand, geometric features (irregularity in the plan and height of the dome, the presence of large openings, height changes in the cross section as well as the presence of the dome or an internal inclined arch) play an essential role in the seismic performance of the building.

Keywords: Taj al-Molk Dome; Seismic Horizontal Loads; Geometric Characteristics; Abacus Software

1. Introduction

Mosques, as the most important structures built in all historical periods of Islamic architecture, have a unique place in research and investigations (Ebad, 2013: 940). The Jameh Mosque or the Atiq Mosque, also known as the Old Mosque, is known as the oldest mosque in Isfahan, Iran, and represents the history of construction of the mosque in Iran that is more than a thousand years old.

* Corresponding author. Tel: +98-9130992769.
E-mail address: r.abouei@aui.ac.ir

The building, which displays all kinds of scientific methods, styles, and decorations of Iranian architecture at the same time, was recognized and registered as an international heritage site in 2012. This historical complex covers an area of 170 * 140 m^2 in the northeast of Isfahan and near the Old Square and includes parts such as the domes of Nizam-ol-Molk and Taj al-Molk, the four-porch courtyard, the Shabestans around the mosque, Muzaffari School, and the famous altar of Oljaito. The oldest date discovered inside the mosque is related to its northern dome, i.e. the dome of Taj al-Molk or Khaki Dome, based on an inscription dated 481 AH (1088-1089 AD) and this date has been engraved at the end of the circular inscription on the neck of the smaller of the two Seljuk domes. In the present study, the behavior of the historical dome of Taj al-Molk is analyzed under the horizontal seismic loads using a three-dimensional finite element (3D FE) model. Nonlinear dynamic analysis on the model was carried out using a real accelerograph with different peaks of the Earth acceleration. For the above structure, a model with plastic failure with the hardening property in both compressive and tensile stress states was used. Given the importance of preserving historic buildings, the investigation of the factors affecting the destruction and the creation of mechanisms of destruction is a priority (Andreea clim et al, 2017: 65). Protecting historic buildings against seismic loads is of great strategic importance, which should be given serious consideration by the relevant organizations in order to keep these precious heritages from being destroyed.

2. Materials and Methods

This study was developed based on the descriptive-analytical method and the information required for the analysis of the architecture of the Taj al-Molk Dome was collected in a documentary-library manner as well as field observation and photography. In the following, the finite element method (numerical method of structural analysis) was implemented in Abaqus/Standard CAE software to investigate the horizontal seismic loads on the dome.

3. Selected Properties of Materials

A masonry structure is formed by a regular construction to behave in a suitable and in a preferably complex way. Along with its main axes, this material exhibits orthotropic characteristics in the form of tension with very low strength and consequent tensile damage, differences in tensile and compressive fracture levels, plastic deformation, and failure during the emergence of cracking due to compression, re-hardening, and the like. Some of the main causes of such complex behavior have been previously demonstrated with good approximation in experimental samples under static loads and in numerical models. One of the main obstacles in the behavioral estimation of a masonry structure stems from the fact that the masonry structure has a strange and unknown behavior in relation to its texture (regular or irregular, and if regular, in its dependence on the arrangement and formulation of its brick parts), typology of the units (concrete, clay, perforated or non-perforated, and the shape of each unit), the arrangement of units, and other items. The reaction of a brick wall to horizontal forces parallel to it, except for the strength and homogeneity of the wall structure, depends on the location and the size of the openings (Chini, 2004: 310). In fact, a wall with its openings can behave like a frame with short and thick beams or like a set of independent vertical beams rigid in base. Given such conditions, it seems that the use of complex models established in the specialized literature is effective in certain cases, but it is not possible as a common general

design. Therefore, plastic failures, which are mainly used in isotropic[†] models mainly for concrete, are also accepted in the case of masonry structures.

On the basis of this behavioral model of materials, during the application of loads in an increasing manner, orthotropic[‡] behavior is completely eliminated, but the average strength and stiffness of the structure along the main axes of the constituent materials still remain the same, in a way that the structural behavior is marginally affected by this inaccuracy. Besides in this model, both failure in tension and cracking in compression are well coordinated with the material model framework, which leads to good development in model stability, in a variety of different problems, including seismic excitation, a subject that is of paramount importance for the masonry structures.

It is worth noting that for the analysis of masonry structures, only the use of compatible 3D FE models is recommended. Such models must be capable of reproducing the strength and stiffness of a material after destruction, which emerge by masonry materials in the non-linear range. Based on such an approach in analysis, and considering the geometric effects of large deformations and nonlinear behavior of materials, the Concrete Damage Plasticity (CDP) model, which is fully available in standard analysis and design packages in the software like Abacus is used for masonry structures. The CDP model is based on the assumption of linear isotropic failure of materials, along with separate criteria of compressive and tensile failure. This model is generally suitable for functions in which materials, especially under loading-unloading modes, exhibit failure, and are therefore suitable for seismic analysis of the structure. Therefore, in this model, there will be a separate nonlinear behavior for tensile and compressive stress, as shown in the figure below.

To describe multidimensional behavior in the nonlinear range, it is assumed that the masonry structure follows the Drucker-Prager resistance criterion with the unrelated flow rule. The resistance range of a standard Drucker-Prager level, modified by a concept called the Kc parameter, is equal to the ratio of yield stress in the three-axial tensile test to its corresponding value in compression mode (Figure below). The Kc parameter is taken as 0.666 in numerical modeling.

[†] With similar physical characteristics

[‡] Is a special state of isotropic, namely their properties depend on the direction on which they are measured. The orthotropic materials have two or three orthogonal axes and in general, the mechanical properties of materials along each axis differ from those along the other axis.

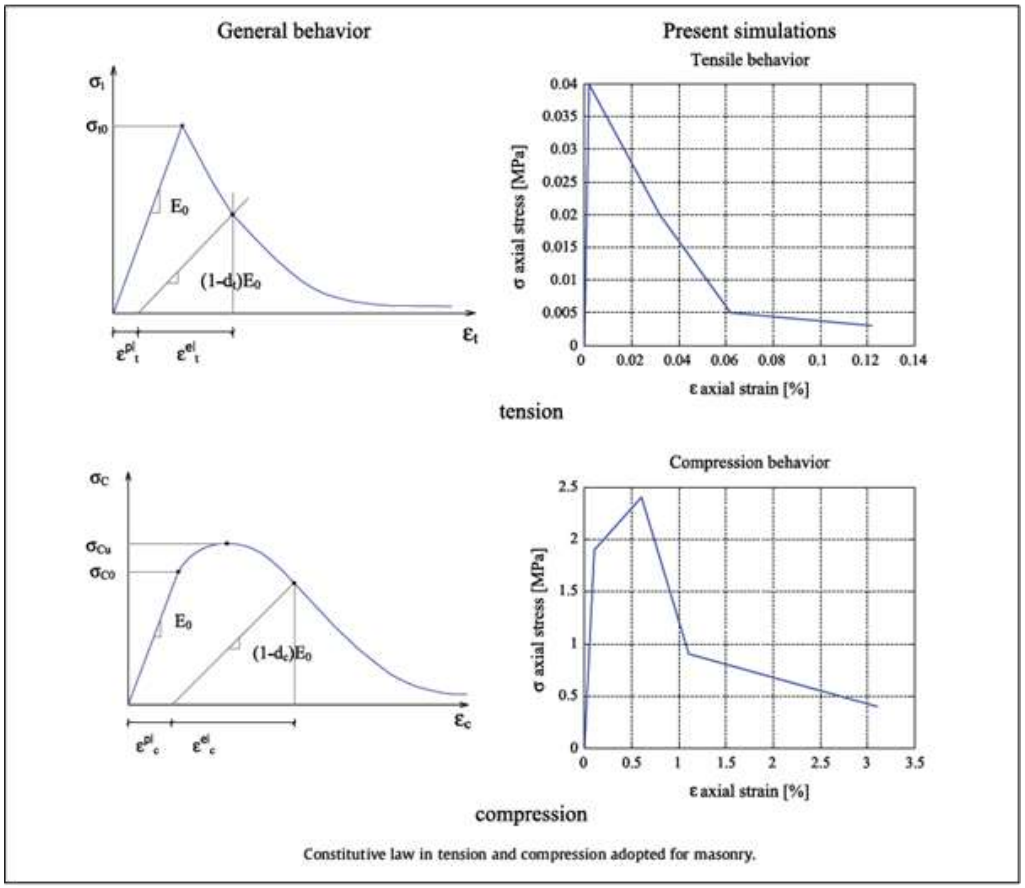

Fig 1 Plastic strain and non-elastic strain in the graph of the concrete response to a uniaxial load. Above: Tensile, below: Compressive (Rafati and Toosi, 2014: 3)

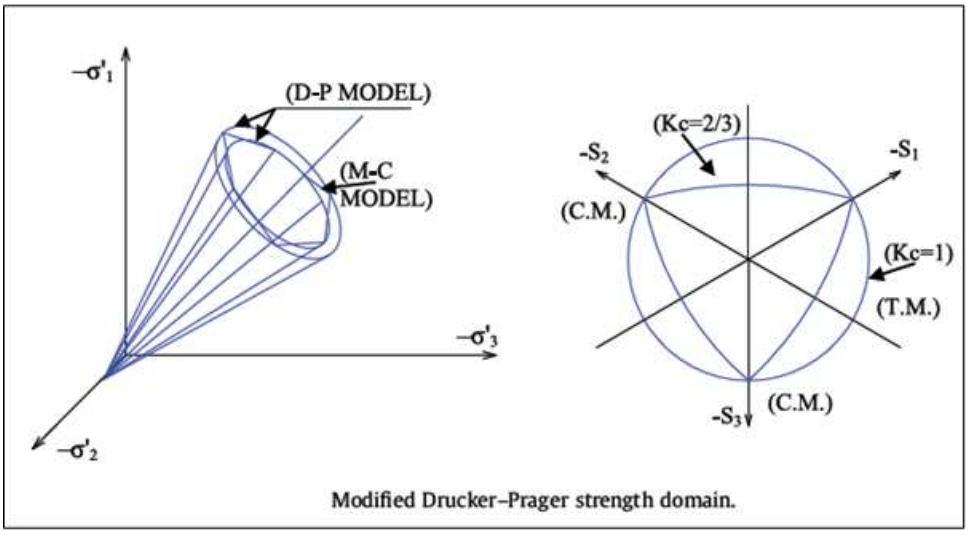

Fig 2 Drucker-Prager boundary levels. Right: General shape. Left: Deviatoric plane (Shakibapour and Raouf Sheibani, 2018: 6)

A 10-degree angle is chosen for the angle of dilation, which is acceptable for a masonry structure exposed to vertical pressure in the range of medium to low stress. This value is in line with the empirical evidence available in the literature of this type of structure. To prevent cases and problems of non-convergence in the analysis, the tip of the Drucker-Prager cone is softened using a hyperbolic curve (Cong Lu, 2009: 35). Abacus software allows for the softening of the resistance range by a concept called the eccentricity parameter. This parameter provides the distance between the points of contact of the cone and the hyperbola with the p-axis on the p-q plane, where the p and q axes are the compressive hydrostatic stress and the equivalent Von-Mises stress, respectively (Figure below). In numerical modeling, a value of 0.1 was accepted for the eccentricity parameter.

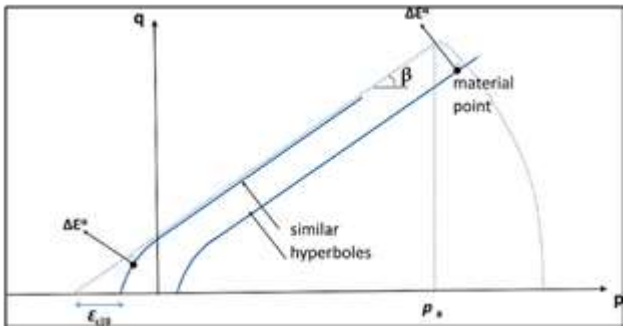

Fig 3 p axis: compressive hydrostatic stress, q axis: equivalent Von-Mises stress (Cong Lu, 2009: 35)

The available experimental results for conventional masonry structures show a moderate orthotropic ratio (in the range of 1.2) under biaxial stress states in compressive-compressive regions. Obviously, such a feature cannot be considered where in an isotropic model like the current ones.

Of course, in the literature of this type of structure, the use of other isotropic models (such as the model with the behavioral function of concrete smeared crack), as a behavioral model definable in both Ansys and Abina software is generally accepted after matching the parameters, which is performed to calibrate the average behavior in the vertical and horizontal compressive stress states.

An appropriate model also counts the ratio between the ultimate compressive strength in the biaxial stress states to the corresponding value in the uniaxial stress state. Such a ratio, which is the same for concrete and masonry structures, is logically considered equal to 1.16. The values of the various parameters accepted for numerical modeling of the masonry structure are reported in table 1.

The stress-strain relation in the final state accepted for dynamic analysis consists of a linear elastic section to the maximum σt stress, which is then directed to the microscopic hardening stage with the emergence of formation of hairline cracks and their development within the material. In the case of compressive stress, the reaction of the material to stress is linear until the yield stress σc. A linear hardening is then assumed until the cracking stress of σcu, followed by the non-linear hardening section. The failure variables in tension dt and compression dc are defined by the following standard relations:

$$\sigma_t = (1 - d_t)E_0(\varepsilon_t - \varepsilon_t^{pl})$$

$$\sigma_c = (1 - d_c)E_0(\varepsilon_c - \varepsilon_c^{pl})$$

Table 1 Values of the parameters accepted for numerical modeling of the masonry structure (Source: Authors)

Values of the parameters accepted for numerical modeling	
Parameter	Value
Poisson ratio	0.2
Angle of dilation	10
Eccentricity	0.1
σbo/σco	1.16
k	0.666
Viscosity	0.002

4. Analysis

In this project, nonlinear dynamic analysis was selected with one level of numerical complexity in order to cover the structure of the dome, which has an average to high complexity in function. In this regard, the following should be regarded: The structure of the dome for the analysis of a three-dimensional meshed model with modified four-sided elements included Quadratic tetrahedron, type C3D10M elements with 30994 nodes and 17595 elements. In this modeling, the dome structure-foundation interaction was ignored and the foundation was considered to be rigid. Generally, the damping of the masonry structures is taken about 2 to 5%. Therefore, in this project, the damping property of the materials of this building was considered to be approximately 3% for the first mode of vibration of the structure. Assuming the Riley damping method, the β factor for the natural frequency of the first mode of vibration of the structure for 4.7217 was equal to 2*.03/4.7217 = 0.0.0127. Since significant nonlinear states, such as the probability of instability due to cracking, are expected in the structure, general convergence in analysis is expected to be non-uniform. In such cases, the automatic option should be selected to adjust the parameters related to the time components in order to prevent untimely interruption of the analysis process. In this regard, the related parameters were set as follows:

Tolerance of the half-increment residual = 1e07

Maximum time increment = 0.02

While pre-seismic analysis mode can be run in abaqus/explicite, the quasi-static analysis mode is much more efficient in abaqus/standard. On the other hand, abaqus/explicite requires a very high number of time components because the stable time component (6e-10) is much smaller than the total time of the earthquake. Moreover, the use of double precision and mass scaling affects the dynamic reaction of the structure. The implementation cost in abaqus/explicite is very high due to the very small size of the element. Moreover, because the earthquake load is of a relatively long duration relative to the time components, the time components in this type of analysis will be very large. Therefore, for this type of problem, abaqus/standard is more effective than the abaqus/explicite analysis. So here the solution starts with gravity loads in the abaqus/standard analysis and the results with continue with abaqus/explicite. A significant number of nonlinear functions have symmetrical Jacobean matrices, and this matrix does not change much in one resumption of the analysis compared to the next resumption. Implicit dynamic problems with smaller time components relative to the natural vibration period of the structural response are examples of this case. In this case, in particular when the problem is of a large dimension, using an

alternative to the Newton method approximation in solving nonlinear equations will reduce the running costs. The quasi-newton method is such an alternative that has been presented by various researchers for systems with symmetrical Jacobean matrices. This method can be used in abaqus/standard that can be replaced by the Newton method, which is the default of this case. In case of selecting this method, a value must be selected for the allowable resumption of the analysis before the base matrix is deformed. The maximum resumption value is 25 and the default value is 8.

5. Nonlinear Dynamic Analysis

In the first stage, gravitational loads are slowly applied to the structure, without the structure being subject to gravitational acceleration. In the second stage, the horizontal movement of the earth on the structure base (the interface of the structure and the earth) are applied to the structure in the presence of gravitational loads. However, in several technical studies, it has been indicated that the application of the vertical component of the earth's motion does not have a significant effect on the masonry structures. Therefore, its effects have been neglected in the present study. In this study, the acceleration curve obtained from real accelerographs in the Tabas Earthquake, Iran, was used to evaluate the seismic response of the dome. This curve was applied to the structure after normalization to gravity acceleration (according to code 2800, the maximum acceleration will be equal to the gravity acceleration) with a coefficient of 0.3 g (PGA = 0.3 g). In summary, the structure was first subjected to the gravitational load due to the weight of the structure itself in STEP1 and then in STEP2 was exposed to the lateral load of the earthquake. The gravity acceleration coefficient in the application of the inertial seismic load on the structure is equal to 0.3*g. The acceleration applied to the structure is presented in the following figure.

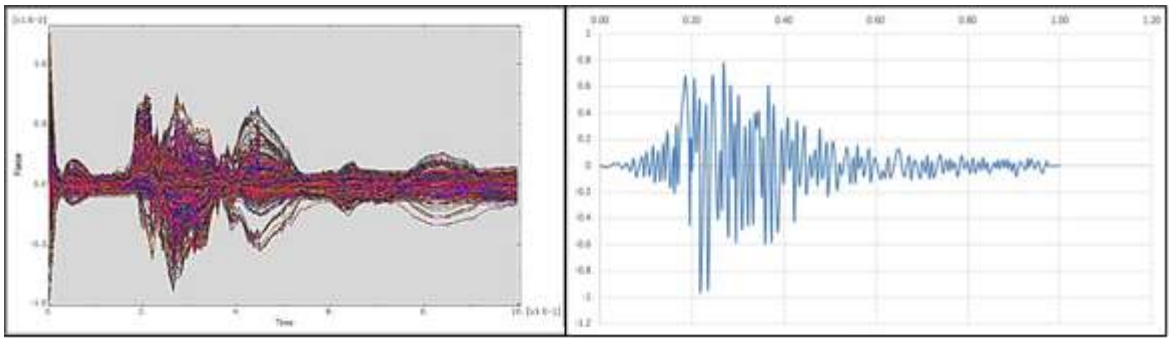

Fig 4 Right: STEP1 (Graph of acceleration applied to the structure); Left: STEP2 (Graph of distribution of the support force in the nodes of the structure floor); Reference: Authors

The provisions of Code 2800[§] in this regard are as follows:

2.5.3.3. A pair of accelerographs selected for three-dimensional analysis of structures should be scaled as follows:

[§] Building Design Regulations against Earthquake, Standard 2800, Road, Housing and Urban Research Center, Edition 4, Publication Number: D-253

A. Each pair of accelerographs is scaled to their maximum value. This means that the maximum acceleration in the component with the larger maximum value is equal to the gravity acceleration g.

B. The acceleration response range of each pair of the accelerographs scaled should be determined considering 5% damping ratio.

C. The response ranges of ... are compared with the standard design range. The scale factor should be determined so that ... in no case is less than 1.4 times the corresponding value of the standard range.

D. The scale factor determined must be multiplied by the accelerograph of paragraph A and used in dynamic analysis.

At the end of the time history analysis, the horizontal displacement of some control points during the occurrence of the failure phenomenon, generally the higher nodes of the structure, were qualitatively examined in order to determine whether the structure was in the initial stage of destruction or not. The numerical analysis was conducted with a dynamic approach based on implicit integration over time and using a time interval of 0.005 seconds, which corresponds to the time interval for recording the acceleration function. The results of the nonlinear dynamic analysis resulting from the implementation of the program are presented in the next section.

6. Numerical Results of Nonlinear Dynamic Analysis

The time history of acceleration, velocity, and displacement of the control node (above the dome) in the direction of the y-axis and under the ground acceleration with PGA = 0.3g under dynamic nonlinear analysis are presented in the following figures:

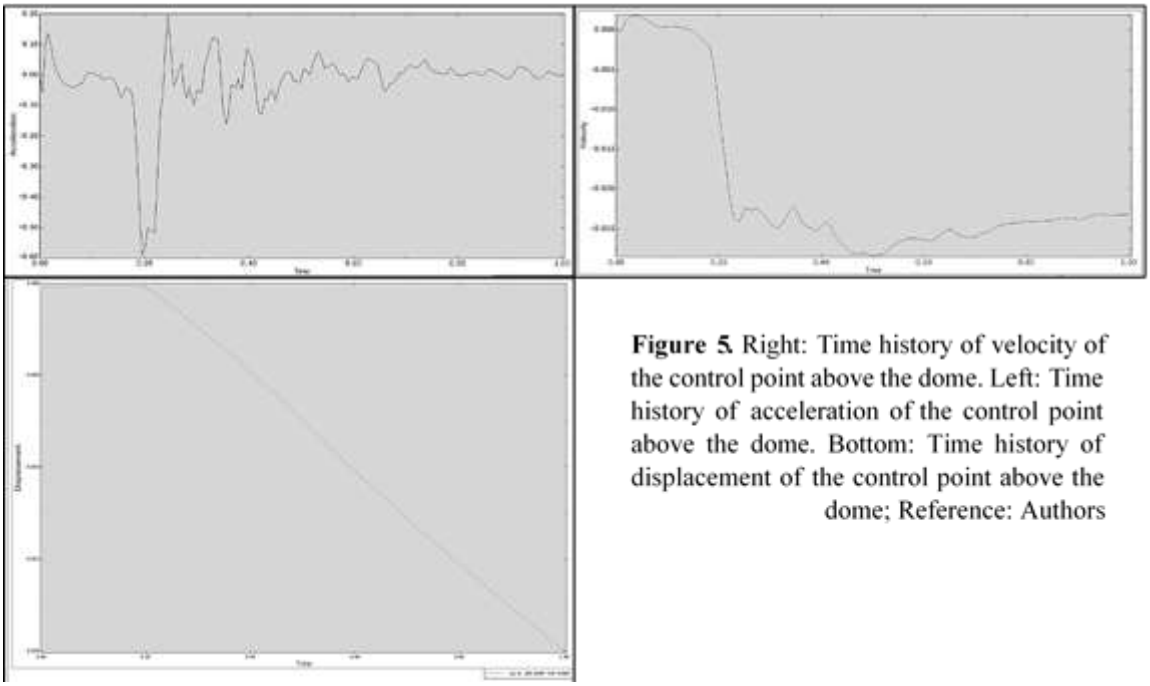

Figure 5. Right: Time history of velocity of the control point above the dome. Left: Time history of acceleration of the control point above the dome. Bottom: Time history of displacement of the control point above the dome; Reference: Authors

It can be roughly stated that if the residual deformation, defined as the ratio of the non-elastic residual horizontal displacement to the height of the structure, is between 0.4% and 0.8%, the structure can be logically considered to be in the threshold of the collapse state. This is clearly the case with the dome structure. The residual deformation values of 0.4% and 0.8% were adopted by

referring to the failure of foundations with masonry materials, respectively, under the shear and bending applied on their planes, which match with the international design codes related to this type of structure. However, the choice of these figures is debatable, because the structural behavior of the dome with the masonry materials cannot be compared with the behavior of individual foundations with the masonry materials. This can only be considered a sign of effort being made in this direction. The dynamic nonlinear analysis is capable of calculating the effects of higher modes that may occur due to local irregularities. The distribution of tensile failure corresponding to displacement is usually similar to the failure pattern observed at the end of the nonlinear dynamic analysis, however numerical values of failure usually show lower values. The only exception is the severe failure observed in the structure base. The strange geometric features and structural configurations of the structure are the main causes of high seismic resistance in masonry structures. Additionally, having thick surrounding walls, the absence of large openings that can facilitate the vulnerability of that part of the structure compared to the whole structure, symmetry in the plane and in height, and providing a regular internal distribution in the structure, are among the reasons for the stability of the Taj al-Molk Dome. In this structure, geometric features and the presence of irregularities in the plan and height have caused failure mechanisms that have been highlighted in the results of the analysis. Relative problems associated with the configuration of the structure, especially the cases related to the symmetry and insufficient regularity in the openings, have affected the structure failure level. The non-uniform distribution of stiffness and strength in the plan and height and the resulting torsional effects can be among the main causes of extensive failure and collapse of the masonry structure.

7. Conclusion

A comprehensive numerical study was carried out on the structure using FE modeling (nonlinear dynamic analysis) with the main objectives as follows:

1. In order to identify some of the general effects due to the geometric and morphological characteristics of the structure, such as openings, wall thickness, and horizontal and vertical irregularities, in the seismic performance of the structure using the finite element 3D model.
2. In order to evaluate the seismic safety of the structure using nonlinear dynamic analysis.

Based on the general analysis and using the results obtained in this study, the following results were obtained:

- The results of the nonlinear dynamic simulation of the structure revealed the high vulnerability of the Taj al-Molk dome structure under horizontal loads. As mentioned earlier, it can be roughly shown that if the residual deformation occurs in the range of 0.4% to 0.8%, the structure can be logically considered to be close to collapse.
- A number of geometric features, such as irregularity in plan and height, large openings, accidental changes in cross section, and the presence of the dome (or an internal sloping arch in the structure) play an essential role in seismic operation. In the analysis performed, the correlation between local geometric items and possible failure modes was clearly revealed by the numerical analyses.
- Furthermore, the results in the frequency analysis of the structure are listed in figure fre-1 presented in the appendix. The results of the first mode were used to calibrate the damping of the materials used during the seismic dynamic analysis of the structure. Figures fre-b (1) to fre-b (20) and fre-f (1) to fre-f (20) in the appendix demonstrate the vibration modes of the structure from the back and front views. The nonlinear dynamic modeling of the structure suggests that the structure of the Taj al-Molk dome is very vulnerable to horizontal loads.

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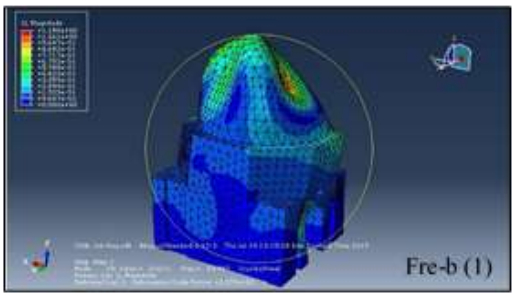
Appendix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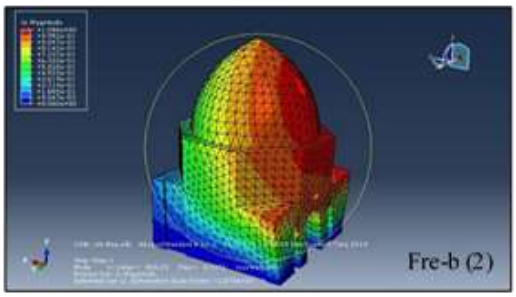
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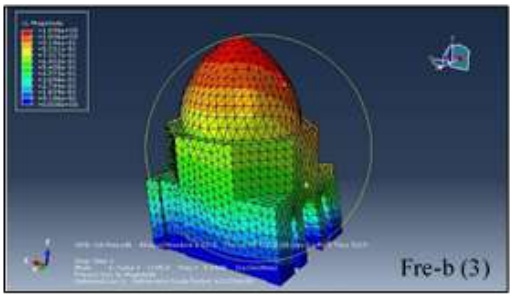
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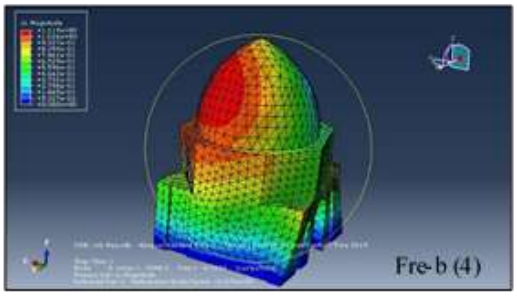
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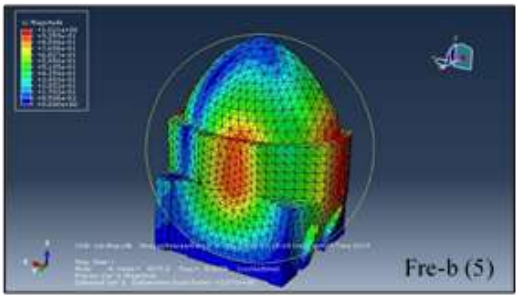
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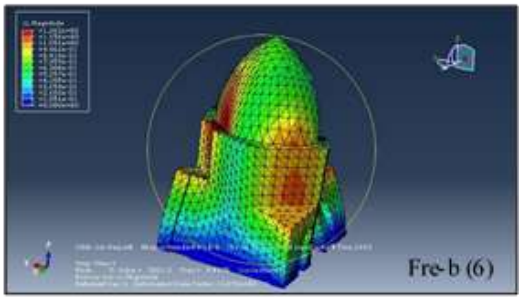
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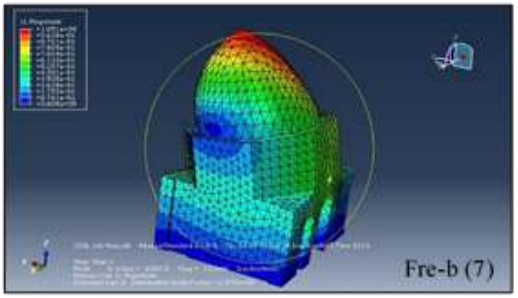
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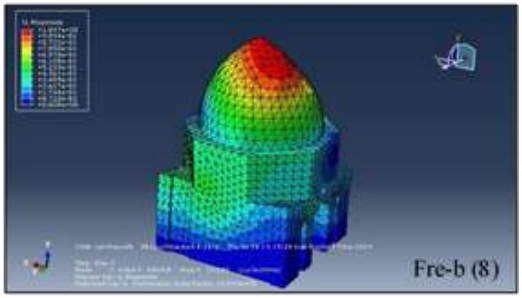
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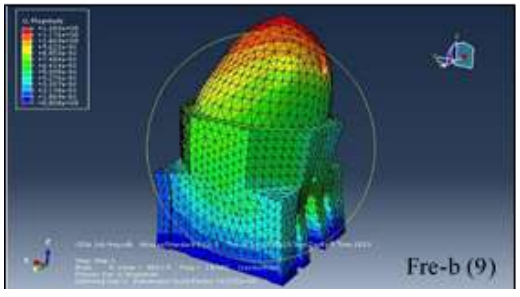
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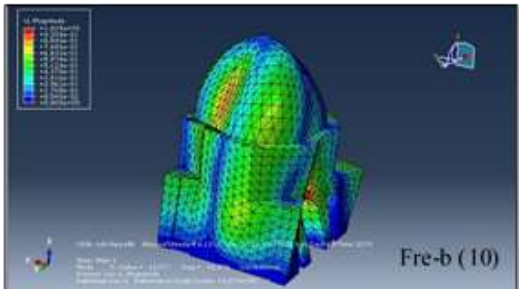
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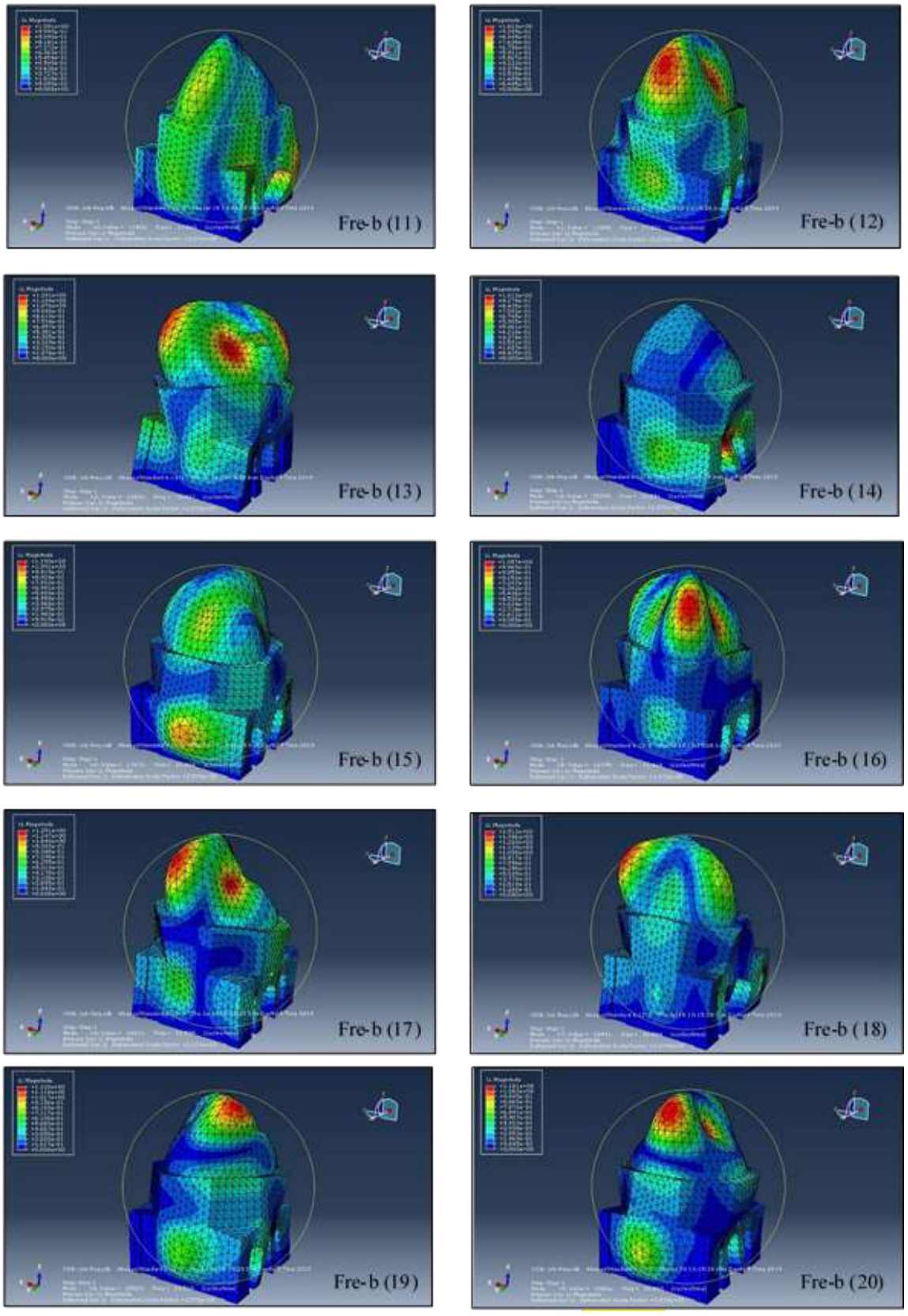
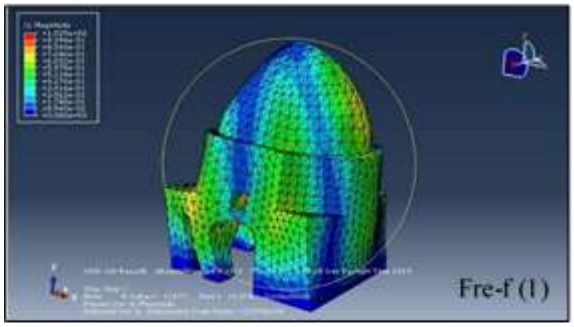


Fig 6 Fre-b(1-20); Vibration modes of the structure on the back view (Source: Authors)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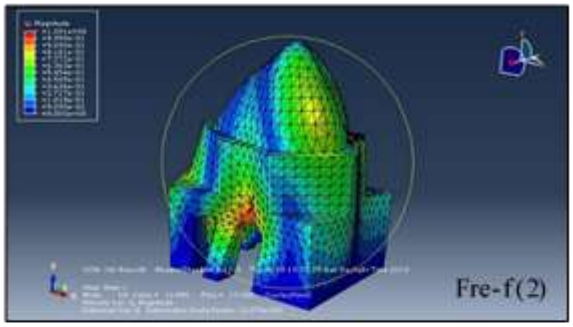
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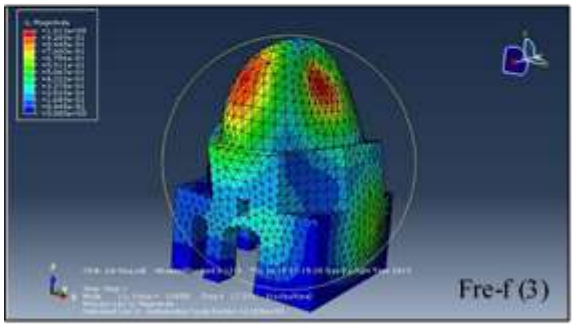
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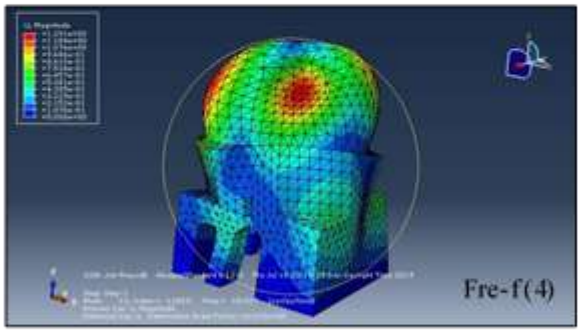
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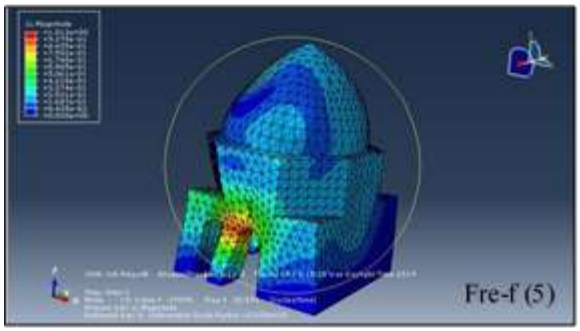
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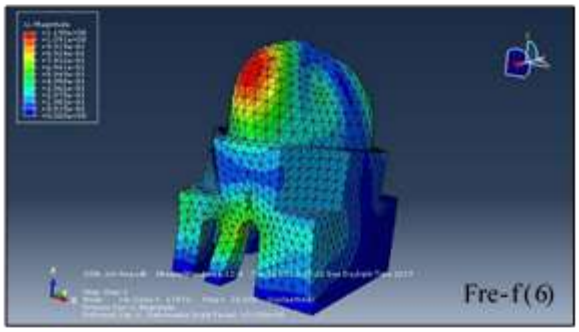
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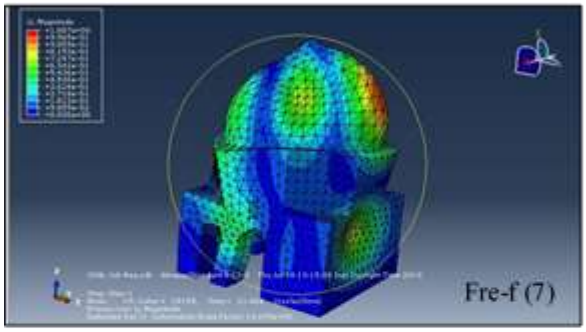
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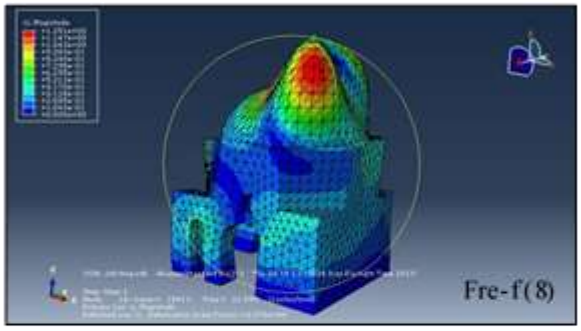
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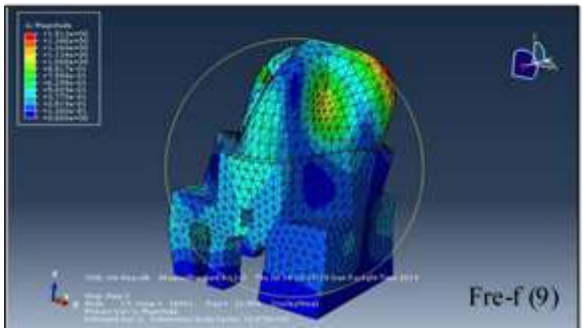
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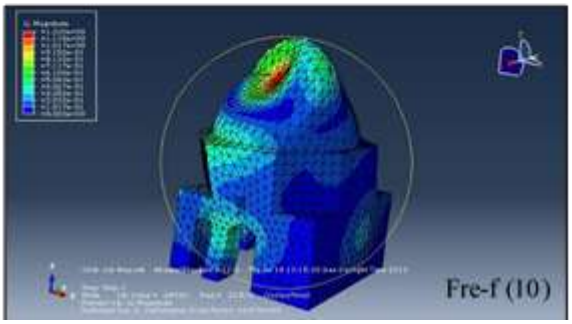
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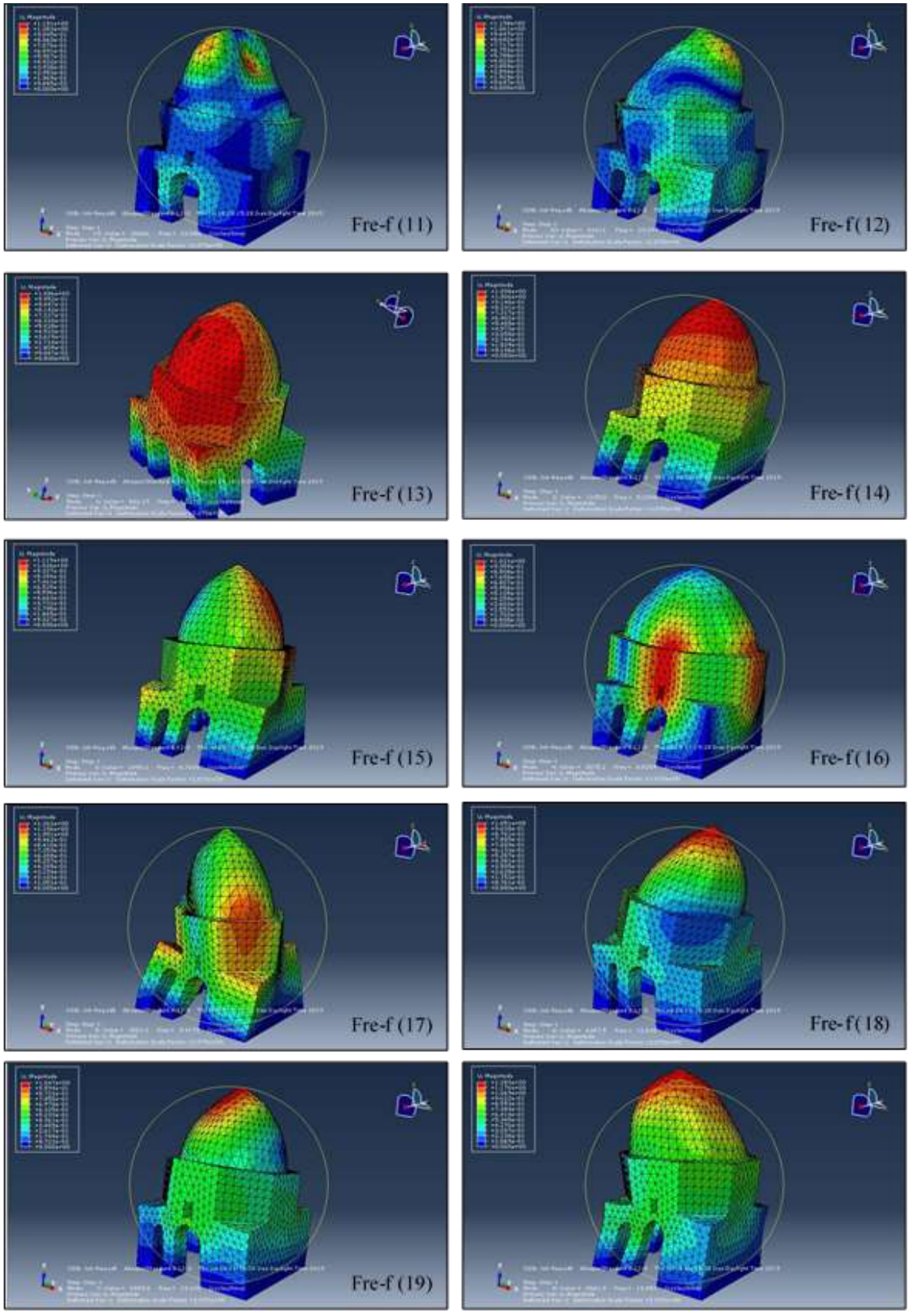

Fig 7 Fre-b(1-20); Vibration modes of the structure on the front view (Source: Authors)

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Reviewing the History of Textile Dyeing in Iran and Introducing the Novel Method by using Nano Technology

Fariba Mohammadisaghand[a], Roya Mohammadisaghand[a], Mehrnoosh Sakenyandehkordi[b]*

[a]*Department of Design and Clothing, Research Institute of Traditional and Modern Structures (RITMS), Yazd, Iran*
[b]*Department of Graphic, Research Institute of Traditional and Modern Structures (RITMS), Yazd, Iran*

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Abstract

This article examines the color position and dyeing of textiles in Iran during different time period. In this research, observing the past dyeing methods and awareness to today's chemical and industrial dyeing, an attempt has been made to produce color shades using nanomaterials. In this research, copper/silver nanoparticles were purchased from Sigma Aldrich Company and using chemical methods two orange-red and brown colored shades was created on cotton fabric. The results showed the success of colors created. Considering the nature of the materials used, it can be stated that these colors do not have any side effects on the environment.

Keywords: Textile; Nano Material; Traditional Dyeing

1. Introduction

Color is an integral element of nature. Most of the living and non-living material in the universe has more or less benefited from color, many objects and phenomena are expressed in colorful forms: from diverse colors of rock, water, soil, colorful flowers and plants, glittering wings and feathers of birds, and rainbow. In other words, color recognition itself is another story. Light-sensitive receptors that work in a complex network of brain and nerve for sight, these receptors in nature according to light resolution and recognition different colors among the living creatures is incomplete. But, by the complex brain system the weak vision is compensated and detects the color spectrum range. Human uses color in various celebrations and ceremonies and gradually learn various ways to obtain color from nature (Jahanshahi Afshar, 2001).

Color covers a wide range of topics from color physics, psychology, tradition and culture. In Dehkhoda dictionary “Color” is the effect of light on the appearance of objects, which is called

* Corresponding author. Tel: +98-9120694957.
E-mail address: mehrsa96@yahoo.com

"hue". Color emerges with the effect of absorption and part of light reflection. In scientific definitions, the wavelength obtain from light radiation is absorbed by objects and after reflection is seen in the invisible color area, that is observed by the eye and analyzed by nerve cells in the brain to understand the type of color by human (Shahparvari et al, 2017).

In Islamic aesthetics color has a special place and studied from a metaphysical point of view. Colors are the distinguishing features of Islamic art that, in addition to its decorative appearance, have a nature and truth which results from the reproduction of light (Shahparvari et al, 2017). Ages ago dyeing has been buried in the dark depths of human life without any definite date for it. But it is certain that over time and development of human societies, simple color methods for dyeing has been converted to more complex techniques. In addition to the use of various minerals material and different parts of plants (stems, roots, leaves, flowers, bark, seeds), humans were able to obtain various colors from insects and plant pests (Jahanshahi Afshar, 2001).

The remains of painting during the ancient period especially cave paintings that have been painted in various forms, depict the long history of human familiarity with dyeing. According to some scholars, ancient Asian civilizations such as China, Iran and India about 2000 years B.C. were completely acquainted with the materials used to dye wool and silk fibers and used it in the best possible way (Jahanshahi Afshar, 2001).

1.1. Color and Dyeing in Iran

Color is one of the main elements in the valuable Iranian artworks. Meantime, the coloring system of Iranian work of art, has always been influenced by factors such as traditional criteria and contracts, social beliefs and religion, mysticism, culture, etc., that have been transferred from generation to generation through one artist to another. The element of color can be studied in one of the most practical handicrafts of Iran, namely cloth weaving in Islamic era: obviously, this handicraft has been influenced by the above-mentioned factors in different Islamic periods, and we evidence the creativity of many Iranian artists in this field. The valuable period in the art of cloth weaving with the presence of the most beautiful element of color can be clearly seen during the Seljuk to Safavid era (Rezaei Azar, 2018).

The common belief of all researchers in the decorative and visual arts of the East is that the Iranians masters have used colors in the artworks of the eighth century to the late Safavid, especially in cloth and miniature carpets (Suresrafi, 1999). The dyeing with natural material has kept its important reflection in the art and carpet weaving industry (Rahimpour, 2019).

In fact, there is no doubt that the colors used in the old Iranian carpets were natural and plant colors, the prominent types as the carpets of the Safavid period are embellishing preservers in the world museums. Till date most of the colors of these carpets has remained attractive and pleasant, and even if they have changed over time, it has been due to their desirability and increasing quality (Suresrafi, 1999).

The most important sources of natural dyes are plants, from which the obtained colors are exposed to sunlight, washing and use that over time find a gentle glow on the fibers. Undoubtedly, the radiance of the beautiful carpets that have remained in the museums of the world from the past, especially the Safavid era, has caused the illusion that natural colors are sufficient and desirable for use in carpets, and if there is a color change in the carpet colors, it has been a pleasant color change. The comparison of plant color with industrial colors (sometimes its stability reaches the highest standards of color stability) is not appropriate (Suresrafi, 1999).

1.2. Color in Fabrics during the Seljuk, Mongol, Timurid and Safavid Period

Colors: Use of different plant materials and insects such as: red seeds, Rubia tinctorum (rose madder), Socotra dragon tree, ginger plant and Anacardiaceae for red color; Sumac (Rhus), saffron, turmeric, Safflower, pomegranate peel, Reseda and grape leaves for yellow color; indigo plant, wood color, Jute plant or litmus for blue color. The mixture of yellow and blue give the green color. The green walnut skin is used for brown color, indigo plant in two different types as black alum (lye), iron rust used for black color (Rezaei Azar, 2018).

1.3. Dyeing in Textiles

In Iran, in addition to various colors used, stabilizing materials were also used to keep the fabric color constant, and to have the desired changes in light color shades. The stabilizers are: alum (aluminum sulfate), Alkali alum (potassium alum), Ammonium alum (Copper and iron sulfate), and extract from terebinth leaves, fresh walnut skin, green pistachio skin, and pomegranate peel (Rezaei Azar, 2018).

This method of color dyeing in Iran is the result of Iranian weaver's experiences in the past centuries, which has been an important factor in the quality of Iranian fabrics and carpets with constant colors (Rezaei Azar, 2018).

1.4. Evolution of Fabric Weaving during the Safavid Period

During the Safavid era in the weaving centers of Iran, fabrics were produced such as silk, borcode (knitted fabrics), velvet, satin, block printed, scarf (cashmere, double and multi ply fabrics) and embossed silk. These fabrics were unique in terms of color variety with beautiful designs and patterns (Talebpour, 2018).

Dyers of the Safavid period obtained different tones of color by combining different materials, which was in fact a diagram of the colors found in nature and included the lightest to the darkest colors (Rezaei Azar, 2018).

1.5. Dyeing

Dyeing is a process in which the color material under certain conditions such as temperature and time affects the fibers or knitted products and dyes it. The carpet dyeing is also part of textile industry. Generally, dyes refer to all natural or chemical materials that have the ability to dye fibers or textiles. Differences can be seen in the comparison between traditional and modern methods due to the application of some traditional materials in dyeing with natural colors. The performance nature and results obtained from natural dyes is scientifically justified and is fully consistent with advanced industrial methods (Suresrafi, 1999).

1.6. Color Selection

In dyeing process, there is a principle in choosing the appropriate color and this issue is applicable to natural and industrial dyes. The concept of a suitable dye in its simplest form is depending on the type of fiber being dyed, (for example; acid dye for wool, and naturally the direct dye used for dyeing cotton fibers cannot dye the wool fibers) (Suresrafi, 1999).

1.7. Nanoparticles

The noble metal nanoparticles have been used since ancient times as decorative pigments for glass and ceramic colors. The famous Dichoric Cup with effect (Dichronic), gold and silver nanoparticles are used as color, an example of the old use of nanoparticles for noble metals in works of art. This cup shows the reflected green color in the light which passes through the bright red color in the light that it is due to the presence of gold and silver nanoparticles in the glass matrix. Silver nanoparticles, as one of the oldest decorative pigments, create not only beautiful colors but also antibacterial properties. Inorganic nanoparticles, especially silver nanoparticles, are cheap, stable and effective in comparison to the organic antibacterial materials. Silver ions have antimicrobial and photoactive properties, and textile products treated with old silver nanoparticles are in limited colors. Consumers want textile products with enhanced functions, such as antibacterial, antistatic, dye resistance and light-ray protection (Johnston et al, 2008; Tang et al., 2011; Metraux and Mirkin, 2005).

2. Practical Work Process (Method)

Cotton fabric was provided by Yazd Baf Company. Silver /copper nanomaterials were purchased from Sigma Aldrich Company. Initially, silver nitrate solution was prepared, and then 2 ml of Trisodium citrate was added with 0.1 gram of Polyvinylpyrrolidone and hydrogen peroxide. Half ml of sodium borohydride solution was added and by using a mixer it was stirred for 30 minutes. It was ultrasonic by adding to it 1% copper and silver nanomaterials. Later, a cotton cloth was added and the ultrasonic was repeated. Finally, the sample was washed with distilled water and dried in an oven. The resulting sample has an orange-red color shade (Figure 1). The same experiment was performed with half percent of nanomaterial which resulted in a golden brown color shade (Figure 2).

Fig 1 Dyed fabric sample with 1% nanomaterials

Fig 2 Dyed fabric sample with 0.5% nanomaterials

3. Conclusion

In this article, dyeing methods and art of dyeing in the past of Iran were studied. Based on the materials presented in the past, the textile dyeing was done using many natural dyes, but despite the fact that industrial chemicals were not used for dyeing, the effluent of these dyes was still harmful to the environment. Today, in most countries, chemical dyes are used for textiles dyeing which has adverse effects. In this article, attempt has been made to create different color shades on the fabric by using nanomaterials so that they can be used as an alternative to industrial chemical dyes. Therefore, using silver/copper nanomaterials were able to create two shades of gold-brown and orange-red on cotton fabric.

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