Abstract
This paper describes and scrutinizes one of the patterns, referred to Yazdi-band, used to decorate the internal surface of domes and semi domes. Yazdi-band is one of the important decorative elements of Persian architecture. Therefore, comprehensive research on the identification and understanding the characteristics, and determine the exact geometry, and classification based on scientific methods seems imperative. The aim of this paper is to identify the unique features of the Yazdi-band as an Architectural-ornamental domes which topped a majority of distinct Interior domes during the early Iranian Islamic era. For this purpose, two samples were chosen out of a total of Yazdi-band in Iranian Islamic architecture. Through an analytic review of selected examples, the paper suggests and addresses the features of Yazdi-band domes, their formal morphological compositions and typological forms based on the number of their Internal from geometry in Iranian Architecture and nearby regions. This study aims are to demonstrate some ways out: Evolutionary Historical of Yazdi-band. The theoretical framework for the formal language of Yazdi-band domes sheds new light on undiscovered information about the essential characteristics of Persian ornamental domes in this region.

Keywords: Persian architecture, Islamic Geometry, Dome’s decoration, Yazdi-band

1 INTRODUCTION
This paper is about Yazdi-band, which is a kind of interior dome decoration in Iranian Architecture. Yazdi-band is the Persian word for interior dome and Iwan decoration. It is an originally Persian type of wall or ceiling decoration, which is used to make a smooth transition from the rectangular basis of the building to vaulted ceiling. However, Yazdi-band are not only used as a dome interior decoration. Yazdi-band also find on Iwan, for example it has generally been recognized that Yazdi-band whether as single buildings or in large complexes of buildings, have played significant role in ornament of Iranian architectural. They are different considerably in sizes and type and materials. We are thus conducted in order to test the

\[1\] Iwan was a trademark of the Parthian Empire (247 BC–AD 224) and later the Sassanid architecture of Persia (224 -651.), later finding their way throughout the Arab and Islamic architecture ("Dictionary of Islamic architecture: Iwan"). An Iwan is a rectangular hall or space, usually vaulted, walled on three sides, with one end entirely open.
applicability and suitability of the dome interior ornamental called “Yazdi-bandi”. For many years "Yazdi-bandi" has been utilized as a decorative pattern for interior place. In the history of "Yazdi-bandi" was never considered as a structural pattern (R.Aldecoa, 2010). Despite several existing studies about the Iranian ornament the Yazdi-band still does not have completely known architectural morphology, typology, geometrical context, and even associated terminologies. The study of characteristics of the Yazdi-band can be manipulated to give contemporary meanings to the traditional designs and principles of the ornament of architecture styles. Also, the developed geometric method has the potential to be used analogically in analyzing and understanding the essences of different sorts of the decorative of Iranian architecture. On the other hand, it can be said geometry is one of the main features in formation of Iranian architecture. Geometrical methods developed in the past cannot be successfully applied for vernacular architecture. The search of innovative geometry has been an interesting subject for Contemporary Architecture (Kourkoutas, 2007) Research in Iranian architecture geometry is impossible without familiarity with geometry. There have been no bright studies which compare differences in architecture technique and mathematics and geometric achievement. Ornament geometry Application in Iranian architecture in two forms: a scientific and practical. Science of geometry encompass the theoretical foundations and its practical aspects covers practices of the concepts, philosophical and mystical, that Iranian architects has benefited to creation of the masterpiece buildings. However, far too little attention has been paid to study the effect of geometry and mathematics in shaping Iranian architecture.

2 METHODOLOGY

As mentioned earlier, research in Persian architecture without knowledge of geometry is impossible. In this regard, this paper seeks to address the following questions: What is the relationship between the progress of Yazdi-band as a decorative element of Persian architecture and its geometry evolution. The research hypothesis is that evolution of geometry and decoration techniques, have a direct impact on the formation and development of Iranian architecture decoration. This is a Fundamental-theoretical research paper. What we know about relation between architecture and geometry is largely based upon interpretive studies that investigate the progress of the Muslims in the Islamic and pre-Islamic historical texts. The study was conducted in the form of a historic-interpretative, with data being gathered via conformity of history, art and science architecture In the Islamic era and earlier, using available resources and library information. This study focuses on the promising pattern which is abundant in the Iranian architecture. This paper attempts to offer a variety of approaches and interpretations of the presence and use of mathematics and geometry in Iranian architecture. Within the framework in this study, the pattern of "Yazdi-band" is introduced as one of the decorative Iranian architecture.

Figure1: Yazdi-band in Abbasian historical house, Kashan-Iran

3 ISLAMIC GEOMETRY

The word geometry refers to the science of properties and relations of magnitudes such as points, lines, surfaces, or solids in space and the way the parts of a particular object fit together (Concise Oxford English Dictionary, 1999). Geometry is well known based on two Greek words “geo”, meaning
the earth, and “metry”, meaning to measure. Geometry possesses abstraction and the capacity to express and reveal objectively immutable and spiritual truths. Geometry involves proportions and prime roots that are considered the most beautiful proportions (the proportions of beauty). As such, beauty, for the Muslim artists, is objective and self-expression of truths, which is the essential nature of beauty as Plato stated, “Beauty is the splendor of the truth”1. Geometric proportions are used by Muslim designers as the most valuable tool of design process to produce ordered patterns that govern aesthetic beauty in designed spaces, surfaces and objects. They present us the “Principles of Nature” in their own language. By applying the golden mean (Phi) and the root proportions, geometric patterns are produced to be applied to the fields of building crafts, such as tiles, mosaic, plaster and wood, as well as to the field of book art. The striking beauty and harmony of the varieties of patterns that characterized the interiors as well as the exteriors of domes indicate the involvement of knowledgeable artisans or mathematicians of that time. The “ulema”2 have been the biggest influence on formation of elements of architecture. For example, “Abu al-Wafa' al-Buzjani”3 author of the most widely used books on architecture such as “Al-Handasa4” and “Kitāb fi mā yaṭṭaj ilayh al-ṣāniʿ min al-a’māl al-handasiyya5 ” are believed to have been written much later than the earlier manual, although, as the Encyclopedia of Islam suggests, it might have been a collection of his lectures penned down by one of his students. It mentioned the interactions of artists and artisans with mathematicians on topics such as geometric constructions of ornamental patterns and the application of geometry to architectural construction. "The book came in thirteen chapters addressing the design and testing of drafting instruments, the construction of right angles, approximate angle trisections, constructions of parabolas, regular polygons and methods of inscribing them in and circumscribing them about given circles, inscribing of various polygons in given polygons, the division of figures such as plane polygons, and the division of spherical surfaces into regular spherical polygons. It also accommodated, says Suter, a large number of geometrical problems for the fundamental construction of plane geometry to the construction of the corners of a regular polyhedron on the circumscribed sphere (Nurit & Bosworth , 1997)." Or in other words, a great scientist, Ghiyâth al-Dîn Jamshid Kâshânî6 who played a significant role in the interaction and concurrence among mathematicians and architects, by addressing the relation between architecture and mathematics in two areas of knowledge, theoretical and practical (Taheri, 2009), described practical methods (in designing, drawing and implementing) while elaborating Muqarnas7 construction and calculations (Al-Kâshi, 1977, p. 37), which made it possible for mathematicians and architects to establish a common language. Al-Kâshi uses geometry as a tool for his calculations, not for constructions. Besides arches, vaults, and domes, al-Kâshi calculates here the surface area.

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1 Ulama (Arabic: علماء ‘Ulamāʾ, singular علم أ ‘Ālim, 'scholar”), also spelled ulema and "ulama", refers to the educated class of Muslim legal scholars engaged in school

3 He was a Persian mathematician and astronomer who worked in Baghdad. He made important innovations in spherical trigonometry, and his work on arithmetics for businessmen contains the first instance of using negative numbers in a medieval Islamic text.

Buzjani was one of the leading astronomy and mathematicians of the Middle Ages. With significant contributions in observational astronomy. His achievements in trigonometry paved the way for more precise astronomical calculation (Hockey, 2007, p. 188).

4 “The Geometry”

5 “A Book on Those Geometric Constructions Which Are Necessary for a Craftsman”

6 al-Kâshi (c. 1380 Kashan, Iran – 22 June 1429 Samarkand, Transoxania), is the prominent mathematician and astronomer of ninth/fifteenth century of Islamic civilization who founded the scientific methodology in practical and theoretical knowledge of mathematics in islamic architecture. (Taheri, 2009, p. 77)

7 An architectural ornamentation reminiscent of stalactites, is a type of corbel employed as a decorative device in traditional Islamic and Persian architecture. Iranian architects take the form of small pointed niches, stacked in tiers which project beyond lower tiers, commonly constructed of brick, stone, stucco, or wood, clad with painted tiles, wood, or plaster, and are typically applied to domes, pendentives, cornices, squinches and the undersides of arches and vaults (Curl, 2006).
of a Muqarnas, to say, he establishes approximate values for such a surface (Dold-Samplonius & Harmsen, 2004). In 2007, Peter J. Lu of Harvard University and Professor Paul J. Steinhardt of Princeton University published a paper in the journal Science suggesting that Girih tilings possessed properties consistent with self-similar fractal quasicrystalline tilings such as Penrose tilings. This finding was supported both by analysis of patterns on surviving structures, and by examination of 15th century Persian scrolls (Peter & Paul, 2007). However, Gülru Necipoğlu9 points out that we have no indication of how much more the architects may have known about the mathematics involved (Tongo, 2009). She demonstrates that drawings such as shown on scroll would have served as pattern-books for the artisans who fabricated the tiles, and the shapes of the girih tiles dictated how they could be combined into large patterns. In this way, craftsmen could make highly complex designs without resorting to mathematics and without necessarily understanding their underlying principles (Necipoğlu & al-Asad, 1996). With all the definitions presented, what seems essential to say that the brilliance and elegance of Persian architecture was not devoid of geometrical involvement. While there are numerous research works examining the architectural features and aesthetical values of Islamic architecture, research works concerning this architecture from the analytical and technical points of view are still limited.

More precisely, this paper carries 2 objectives:

- Identify geometric Yazdi-bandi classified as one of the decorative elements of the Iranian Islamic Architecture
- Classification of Yazdi-bandies method

4 PERSIAN INTERIOR DOME

4.1 Domes in Iranian Architecture

Iranian design is a rich art form with spiritual and meditative meaning expressed through its infinite pattern. The decorations of domes represent the sky, heaven and what lies beyond the "seven skies" (Sarhangi, 2004). Domes are composed of surface or surfaces and ribs that distribute loads in plane or along the ribs. Surface domes have greatest efficiency when resisting evenly distributed loads.

Ribbed domes have a greater capacity to resist asymmetrical loading domes can vary I kind according to the way they direct loads toward the ground. Accordingly, the system of domes is divided into seven primary subsystems, ”kaseh_sazi”10 domes and muqarnas domes. These subsystems

8 Girih is an Islamic decorative art form used in architecture and handicrafts (book covers, tapestry, small metal objects), consisting of geometric lines that form an interlaced strapwork. In Iranian architecture, gereh sazi patterns were seen in banna'i brickwork, stucco, and mosaic faience work.

9 Director of the Aga Khan Program of Islamic Architecture at Harvard, HAA Department.

10 Making a decorative bowl covered in Persian architecture that consists of a combination of several pendants (pornaderi, 2008, p. 105).
are determined by the way loads are distributed along the surfaces or line of the domes and the degree of subdivision of their surfaces (Moussavi, 2009).

4.2 Different Kinds of Domes

Domes in Iran have two types first dome with second decorative domes, under these three main categories, many other types of domes can be classified, such as Yazdi-bandı domes. In this context, there are two main possibilities, within which are three others, as listed as follows (Moussavi, 2009): **Yazdi-bandı is a derative dome.**

Table 1. Classification of Ornamental Domes

<table>
<thead>
<tr>
<th>Types</th>
<th>Name Domes</th>
<th>particulars</th>
<th>3D Model Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>Surface</td>
<td>distribute loads along a continuous surface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ribbed</td>
<td>Distribute loads along the ribs and along the infill surfaces between them.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stacked arch</td>
<td>Distribute loads along a surface which is composed of interlocking diamond shaped modules.</td>
<td></td>
</tr>
<tr>
<td>Architectural - Structural</td>
<td>Kar_bandı</td>
<td>Distribute loads along a surface which is formed by cross vaults and pendentives. A small dome is often used to cover the arches produced the combination of cross vaults and pendentives.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kaseh_sazl</td>
<td>Distribute loads along a surface which is formed by shallow domes resting on a set of pendentives and pointed arches</td>
<td></td>
</tr>
<tr>
<td>Architectural</td>
<td>Yazdi -bandı</td>
<td>Distribute loads along a surface which is composed of interlocking diamond shaped modules.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minqarnas</td>
<td>Distribute loads along a highly subdivided surface formed by the stacking of a series of horizontal tracks which are in turn composed of four repeating corbelled elements.</td>
<td></td>
</tr>
</tbody>
</table>

1.  
2.  
3.  
4.  
5.  
6.
5 YAZDI-BANDI

Definition of Yazdi-bandí is difficult because someone like "Ostad Lorzadeh"11 and "Saeed Fallahfar" classified it between Rasmibandi12 and Muqarnas (Raeiszade & Mofidi, 1995) (Shaarbaf, 1993). In other hand "ostad shaarbaf" classified it in karbandi group (Shaarbaf, 1993). Dehkhoda said in his Dictionary: Yazdi-bandí in terms of masonry is an ornamental element that used on the vaults (Dehkhoda, 1995). Local usage of "Yazdi-bandí" is mainly in interior dome, mainly entrance in masque and big houses.

This study focuses on the promising pattern which is abundant in the Iranian architecture for many years "Yazdi-bandí" has been utilized as a decorative pattern for interior place in the history of "Yazdi-bandí" was never considered as a structural pattern (Shaarbaf, 1993). The Yazdi-bandí dome base unit is a tier, or track, composed of smooth. Finely grained, diamond shaped modules of different sizes, with very small flat and horizontal star shape pieces in between. Each tier interlocks with the tiers above and below. Yazdi-bandí domes direct the loads along the diagonal borders between the diamond modules, and along the surface between these lines. The distribution of loads along the lines and surfaces of Yazdi-bandí dome embeds it with an optical affective property of diamonding and gradation that remains consistent within any space it defines. The variation of curvature of Yazdi-bandí domes creates an acoustical effect of diffusion that dominates any focusing form the overall dome shape. This diffusion is enhanced by any diamonding of the surface (Moussavi, 2009). The Dome of Yazdi-bandí paved the way for more daring Iranian-style cupola ornament constructions in the Muslim world, such as the Mausoleum of Khoja Ahmed Yasavi and the Taj Mahal. Much of its exterior decoration has been no decorations, but the interior decorates superb Patterns, brick, and stucco.

6 BACKGROUND

6.1 History Researches

In this section, comprehensive research has been done. This previous studies conducted in this area can help us to use it in our studies for find a good result.

6.2 Historical outline of the origin and development of the Yazdi-bandí in historical architecture

7 History of Yazdi-bandí

In the middle of the tenth century Yazdi-bandí began to develop in Iran. Although the developments occurred simultaneously, it is not known whether they were related. Yazdi-bandí spread throughout the Islamic world from the eleventh century on.

In Seljuk, Ilkhanid and Teymurid other materials were used than those who were custom in Safavid period. Instead of "sun dried bricks", also stucco and tile were used to build a Yazdi-bandí. This led to the creation and evolution of original Yazdi-bandí styles. Therefore there are many different styles of Yazdi-bandí which cannot be properly categorized. Unfortunately, after the end of the Qajar dynasty in 1925 the traditional Yazdi-bandí culture stagnated because of the modernization.

11 Lorzadeh in all fields such as architecture formalization, Mogharnas bowl, and skill of the nodes. If the architecture in an overall perspective, we, the biggest feature is that their concept lax. In fact, the biggest and most common way is to do the work at the top, thanks to the degrading and not man (mofid & raieszade, 2005, p. 14).
12 Manner Karbndy the intersection of the arc, there are a few on Trubhha and slim leg comes up (seyyed sadr, 2002, p. 306).
13 Ali Asghar Sherbaf (born 1932, Tehran ), Master of traditional architecture and restoration of monuments in Iran. Tehran is one of the last remaining traditional architects A.A. Shrbaf.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Date</th>
<th>Title</th>
<th>Source</th>
<th>Method</th>
<th>Case Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alain Judet, 2012</td>
<td></td>
<td>Overview of the presence of mathematics in Persian architecture</td>
<td>Analysis of different kinds of symmetries, starting from the simplest and oldest to those that are more complex, disregarding Chronology or geography within the lands of Persia</td>
<td>Complementary set of selected pictures of Persian</td>
<td></td>
</tr>
<tr>
<td>Maha Kharrazi, Bina Alhami and Mahmood Tavassoli, 2012</td>
<td></td>
<td>examine pre-Islamic ornaments of the Sassanid period in regards to geometric friezes - patterns</td>
<td>This article contains drawn analyzers of various types of patterns that in repetition create groups of associated forms</td>
<td>Id source ornament such as: motifs as part of the whole</td>
<td></td>
</tr>
<tr>
<td>Carol Eise, 2012</td>
<td></td>
<td>critical study of overlapping polygons and radial symmetries</td>
<td>Includes analysis of the geometric patterns that appear on the tynpanums of Gomﭱe-i Surkh in Mashhad and on the western tomb tower at Khwarqum</td>
<td>the overlapping polygons and radial symmetries of the tynpanums and the protomes and squares of the tynpanums of the later arqumaght tomb tower nearby</td>
<td></td>
</tr>
<tr>
<td>Maryam Ashkani and Yuban Ahmad, 2012</td>
<td></td>
<td>Introduce typologies of dome structures and their tectonics</td>
<td>Examining a variety of dome structures across history</td>
<td>Conical and polyhedral domes from the Seljuk era throughout the Timurid period in Iran and nearby regions</td>
<td></td>
</tr>
<tr>
<td>Horman Koliji, 2012</td>
<td></td>
<td>role of geometry in vault structures</td>
<td>Interpretive - Intellectual</td>
<td>Friday Mosque in Isfahan</td>
<td></td>
</tr>
<tr>
<td>H. Lynn Rodner, 2012</td>
<td></td>
<td>Euclidean Constructions of Two Nine-and Twelve-Pointed Interlocking Star Polygon Designs</td>
<td>Analysis of two star polygon girth patterns used from the fourteenth to the seventeenth centuries</td>
<td>Girih with Persian origins</td>
<td></td>
</tr>
<tr>
<td>Carol Eise, 2012</td>
<td></td>
<td>Discussion of the use of tynpanums in pre-modern Islamic ornament</td>
<td>Looks into the geometric patterns of Mirza Akbar, an architect of late eighteenth-century Qajar Iran</td>
<td>Tynpanums designed by Mirza Akbar in the early nineteenth century</td>
<td></td>
</tr>
<tr>
<td>Bina Sarhangi, 2012</td>
<td></td>
<td>study a series of Persian mosaic designs that have been illustrated in scrolls or decorated the surfaces of old structures</td>
<td></td>
<td>Particular series of Persian mosaic designs illustrated in historical scrolls and appearing on the surfaces of historical monuments</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: History Researches source: authors

These Yazdi-bandis were constructed during the Il-Khanid dynasty, which took place in the thirteenth century. In this period Iran, along with parts of Iraq, Afghanistan, Turkmenistan, Uzbekistan and Azerbaijan, was under the reign of a Mongolian ruler (a grandson of Ghengis Khan). Il-Khanid Yazdi-band are a type of brick Muqarnas (according to instance of ornament materials in this period).

Figure 3: Yazdi-band, The Function of Form, source: (Moussavi, 2009, p. 280)
7.1 Historical background of the mathematicians’ role in the design of Yazdi-bandī

In an aforementioned development treatise of the geometric ornaments, the role of the mathematicians can’t be overlooked. Overall speaking, the Iranian mathematic in contrast with the Greek mathematics can also be called “the mathematics of practitioners due to close relationship of theory and practice (Özdural, 2002). Its proper demonstration can be derived from the works of al-Buzjani’s student who recorded contexts of his meetings with master builders and architects to discuss solutions to construction problems [Özdural 1995].

Yazdi-bandī, however, present a wide variety of sizes and types, but some geometric properties were repeatedly used in their composition designs. Nevertheless, no two samples are exactly the same. Visually, the analysis of the pattern of samples revealed three classifications of morphologies. Which embrace the different geometrical properties and architectonic characteristics.

This paper explores Generative Design by means of new Form-finding method application that adopts an idea from Iranian Architecture by evolutionary algorithm (Rasuli, 2010).

7.2 Types of Yazdi-bandī - The morphological features of the Yazdi-bandī in Iranian architecture

Since it is difficult to count the various types of Yazdi-bandīes, the next part will discuss only the most famous types of Yazdi-bandīes used in Iranian’s architecture. From the historical point of view, there are 8 types of Yazdi-bandīes that were used frequently almost in all of Iranian’s buildings.


<table>
<thead>
<tr>
<th>Historical Period</th>
<th>Description</th>
<th>Name</th>
<th>Location</th>
<th>Material</th>
<th>Building Type</th>
<th>Location in Building</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seljuk</td>
<td>Yazdi-bandī Simple and unadorned</td>
<td>Magjd-i-jamīs</td>
<td>Iran-Ardeshtan</td>
<td>Brick &amp; stucco</td>
<td>mosque</td>
<td>Porch</td>
<td>![Picture 1]</td>
</tr>
<tr>
<td>Ilkhanid</td>
<td>Yazdi-bandī combined by other ornament</td>
<td>Abdol-azim shrine</td>
<td>Iran Rey</td>
<td>Brick-tile</td>
<td>shrine</td>
<td>Porch</td>
<td>![Picture 2]</td>
</tr>
<tr>
<td>Timurid</td>
<td>The term of creating Rasta Bandīes Kar Bandī and Māqarnas</td>
<td>Labi Hauz Ensemble</td>
<td>Ush-shāstan Bukhārā</td>
<td>stucco</td>
<td>Garden House</td>
<td>Porch</td>
<td>![Picture 3]</td>
</tr>
</tbody>
</table>


Continued Table 3. Yazdi-bandies classification based on the historical period (Safavids), Pictures from Aga Khan Archive. MIT. (www.Archnet.org, n.d.)
<table>
<thead>
<tr>
<th>Historical period</th>
<th>Description</th>
<th>Name</th>
<th>Location</th>
<th>Material</th>
<th>Building type</th>
<th>Location after building</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yazd, 1300-1394 AD</td>
<td>Jamkaran</td>
<td>Iran, Isfahan</td>
<td>Stucco</td>
<td>House</td>
<td>Perch</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repetitive boxes</td>
<td>Iran, Isfahan</td>
<td>Stucco</td>
<td>House</td>
<td>Perch</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tiled boxes</td>
<td>Iran, Isfahan</td>
<td>Stucco</td>
<td>House</td>
<td>Dome</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alcove boxes</td>
<td>Iran, Isfahan</td>
<td>Stucco</td>
<td>House</td>
<td>Dome</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td>Qajari, 1800-1923 AD</td>
<td>Arshiyal Pahlavi</td>
<td>Iran, Mashhad</td>
<td>Brick</td>
<td>Vezara</td>
<td>Dome</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Natik Allah well shrine</td>
<td>Iran, Mashhad</td>
<td>Brick</td>
<td>Stair</td>
<td>Dome</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laurdak</td>
<td>Iran, Shiraz</td>
<td>Tile</td>
<td>Marque</td>
<td>Perch</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shahid Reza Ali Qochoon</td>
<td>Iran, Teheran</td>
<td>Stucco, Brick</td>
<td>Court</td>
<td>Dome</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sabz</td>
<td>Iran, Qom</td>
<td>Stucco</td>
<td>Marque</td>
<td>Dome</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Sabz</td>
<td>Iran, Qom</td>
<td>Stucco</td>
<td>Marque</td>
<td>Dome</td>
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<tr>
<td></td>
<td>Tomb of Reza</td>
<td>Iran, Qom</td>
<td>Stucco</td>
<td>House</td>
<td>Dome</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sepahshah palace</td>
<td>Iran, Teheran</td>
<td>Stucco</td>
<td>School</td>
<td>Perch</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>House</td>
<td>Iran, Qom</td>
<td>Stucco</td>
<td>Stair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reza Shah garden</td>
<td>Iran, Teheran</td>
<td>Stucco</td>
<td>Panel</td>
<td>Dome</td>
<td>Dome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mirzak &amp; Bahman, Khan</td>
<td>Iran, Teheran</td>
<td>Stucco</td>
<td>Marque</td>
<td>Dome</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued Table 3: Yazdi-bandies classification based on the historical period (three period), Pictures from Aga Khan Archive. MIT, (www.Archnet.org, n.d.)
### Table 4: Different Method of Yazdi-band Drawing

<table>
<thead>
<tr>
<th>Designer</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hussein Iorzadeh</td>
<td><img src="image1.png" alt="Image" /> <img src="image2.png" alt="Image" /> <img src="image3.png" alt="Image" /> <img src="image4.png" alt="Image" /></td>
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<td>2 Asghar Sharbaf</td>
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<td>3 Hossein Zomarhidi</td>
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<td>4 Peyman Rasoli &amp; Aazam Bastani</td>
<td><img src="image13.png" alt="Diagram" /> <img src="image14.png" alt="Diagram" /> <img src="image15.png" alt="Diagram" /> <img src="image16.png" alt="Diagram" /> <img src="image17.png" alt="Diagram" /> <img src="image18.png" alt="Diagram" /> <img src="image19.png" alt="Diagram" /> <img src="image20.png" alt="Diagram" /></td>
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8 CONSTRUCTION METHOD

A Yazdi-band consist of tiers (layers), which themselves consist of elements. Among these basic elements we can distinguish "Star" and "pa-barik". The stars and pa-barik makes cells. The cells look like small small piece of vault. They are the most important in building a Yazdi-band, since they provide the 'body' of the Yazdi-band. The intermediate elements can be used to combine cells together, although they are not essentially needed and can be omitted.

Figure 4. Creating of Yazdi-band-Kashan

9 CASE STUDIES

This study uses only as a benchmark to modeling, and not to the exact values of these parameters for a particular type of structural space presented.

9.1 AMIN-AL-DOLLEH -TIMCHEH (ARCADE), OSTD AL MARYAM14, KASHAN, IRAN, 1900
The nave of AMIN AL DOLLE arcade is formed by the vertical tessellation of a horizontal tier composed of a pendentive like surface form an octagonal plan with eight pointed arches of differing scales on the perimeter to a hexagonal top in the form of a compression ring .the surface is subdivided into a triangulated grid in which each of the facets is kept at approximately the same scale .the scale of subdivision of the pendentive surface is set by the diamond grid, the scale and density of which changes gradually. Through a series of horizontal tiers. To adapt to the contours of the surface .the nave AMIN-AL-Dolleh arcade transmits an optical effect of diamonding, cruciform, gradation and rotundity, and an acoustical effect of diffusion.

Figure 5. Amin-od Dowleh Timcheh, Kashan Bazaar

9.2 Borujerdih Mansion15, Ḥājj Sayyed Ja'far Nāṭanzi, kashan, Iran, 1892
The Borujerdih Mansion. Constructed in 1875, this house is one of the most famous historic mansions in Kashan. It was commissioned by Ḥājj Sayyed Ja'far Nāτanzi, a Kashan merchant who imported goods from historic city of Kashan is. The building is located in the neighborhood of Sultan Mir Ahmad made in the second half of the 13th century AD.

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14 The famous architect Ustad Ali Maryam Kashani, Iran 19th century. Among his famous works are: Home Brvjrtdyha (1857), Home Tabatabaeeian (1840).Timcheh Aminodoleh.

15 Home Brvjrdyha historic city of Kashan is. The building is located in the neighborhood of Sultan Mir Ahmad made in the second half of the 13th century AD.
Borujerd (explaining his appellation). The construction of the exterior guest house spaces (biruni) and the interior private living spaces (andaruni) was completed in 1892, 18 years after it was begun, and more than 150 masons, stucco carvers, mirror cutters, and other artisans took part in its construction (Naraqi, 1969, pp. 288-92).

The south ensemble of the house includes a large "Talar" which is covered by the large dome features of yazdi-bandī and rasmī-bandī decorations, and alternating light apertures which give it a distinctive appearance, seen on many postcards from Iran (Sarhangi, 2004).

Figure 6.: Khan-e Borujerdi. Niche with muqarnas at the rear of the living room

10 CONCLUSION

As noted, geometry is one of the main features in formation of Iranian architecture. Research in Iranian architecture is impossible without being familiar with ornamental geometry. So far researches have only applied to development of geometry separately, not on technical root of Iranian architecture. This paper attempts to address the following questions: What is the relationship between the progress of Yazdi-bandī and geometry evolution. The research achievements was that Evolution of mathematics and geometry, have a direct impact on the formation and development of Iranian ornament architecture. One question that needs to be answered however, is whether the evolution of mathematics and Geometric influence the development of Iranian architecture. According to the findings of the theoretical and practical aspects of research, this paper can be the basis for future studies on the geometry in the Iranian architecture. A strong relationship between Iranian architecture progression and evolution of mathematic geometry has been reported in this literature. The most interesting finding was that by development of mathematic geometric, architecture has progressed and with the fading communication between mathematicians and architects, manufacturing techniques of buildings has deteriorated. However Future studies on the current topic are therefore recommended. More research on this topic needs to be undertaken to association between Architecture and mathematic geometry is more clearly understand.

11 FOOT NOTE

Because it was also found that most papers used terminologies specific to Persian architecture, which may be foreign to Western readers, the board decided to provide the following brief glossary.

Bazaar: A bazaar (from Persian (bazar), meaning "market"; from Middle Persian (baḥā-chār), meaning "place of prices") is a permanent enclosed merchandising area, marketplace, or street of shops where goods and services are exchanged or sold. (www.en.wikipedia.org, 1985)The term is sometimes also used to refer to the "network of merchants, bankers, and craftsmen" who work that area. (Pourjafar, Nazhad Ebrahimi, & Ansari, 2013). The Turkish word bazar derived from the Persian “Pazar” (Petersen, 1996, p. 33).

Gunbad:.an Iranian and Mughal term of dome, usually used for a domed tomb (Petersen, 1996, p. 103).
Kar-Bandi: The interface between design Foursquare far stems dome where it starts, if there is a sub-arcs of intersection, say Karbndy (seyyed sadr, 2002, p. 439). Karbndy building consists of a vault door is covered with geometric rules that determine arcs intersect and shape to create the original cover. Karbndhya, consisting Azbarykh or vault door are a Tqatshan, skeletal covering for ceilings occur and much of the time frame covered by the second and shorter than the main roof, and often as the main roof of used.

Rasmi-Bandi: Technical terms used by masons and architects as an act of making interlocking patterns in construction (Fallahfar, 1999).

Muqarnas: muqarnas is one of the most characteristic features of Islamic architecture and in used throughout most of the muslim world (Petersen, 1996, p. 206). Stalactite-like structures built and hung under vaults or half-vaults. These structures were built out of plaster of paris in horizontal layers and vertical faces and were often covered with glazed tiles, colored glasses, and mirrors.

Yzdybndy: particular type of Karbndy under the dome, covering the decorative arched entries that are normally present in the atmosphere which gives specific expression. Yazdi is a state Ranking the Rsmybndy and Mogharnas (seyyed sadr, 2002, p. 600).

Talar: Talar (Persian words) is the architectural term given to the throne of the Persian monarchs which is carved on the rock-cut tomb of Darius at Naqsh-e Rostam, near Persepolis, and above the portico which was copied from his palace. (www.en.wikipedia.org, 1985).in other definition: Iranian term of hypostyle wooden hall which procced through the main part of a building (Petersen, 1996, p. 276).

REFERENCES


