

The role of Sacred Geometry in forming Islamic art

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Research Summary:

Originator of the heavens and the earth (Al Baqarah – 117)

Everything We created is precisely measured. " إنا كل شئ خلقناه بقدر " (Al Qamar – 49)

If anyone meditates in the verses of the universe and creation he must see the creativity of God in all Gods creations, as we can find that everything is completely arranged and consistency and all the universe is ruled by certain laws, as God created everything by measure and this is the secret of creativity in this great universe.

Scientists researched and studied the geometrical sequences arranging the universe which is the sacred geometry which arranges and controls all the forms of existence and life starting from eye cornea, DNA molecules for humans, flowers petals, diamond crystals, tree branches and animals down to galaxies, solar systems and even the chemical composition of air is arranged in a certain law. The science of sacred geometry depends on deep understanding for these universal aspects and geometrical arrangements which consists it including geometrical forms and mathematical ratios which is used for the design of everything in nature, because of this all old civilizations used it in religious architecture with a special form aiming the creation of spiritual energy field connecting man to universe by using the same ratios of building style, and from here comes the research **problem** which can be determined in the following question: What are the sacred geometry aspects in the arts of Islamic architecture and decoration which acquires it its creative artistic aesthetics? Through the studying of sacred geometry concept, the forms, and mathematical geometrical arrangements used by scientists based on aesthetic proportions in nature and applying this in arts of Islamic architecture and decoration through studying samples of arts of Islamic architecture and decoration. **The research aims to** prove that Islamic architecture and decorations didn't come accidentally but it is based on geometrical and mathematical concepts depending on sacred geometry which arranges universal construction. **The results of the research** refers to the conclusion that Islamic architecture and decoration are all based on the golden ratio of mathematical and geometrical basis which gives it atheists which is clear in the visual sense of comfort through its connection to universal sacred geometry which makes it harmonious with the surrounding universe.

Key words:

Sacred geometry – Golden ratio - Fibonacci sequence - Islamic art – Islamic architecture .

ملخص البحث :

"بديع السموات والارض " البقرة 117 ، " إنا كل شئ خلقناه بقدر " القمر 49 ، إن المتأمل في آيات الكون والخلق يرى إبداع الله في كل ما خلق ، فكل شئ في ترتيب وتناسق تام وكل صور الكون تحكمها قوانين معينة ، فكل شئ خلقه الله بقدر وهو السر وراء هذا الإبداع الكوني العظيم . وقد تناول العلماء دراسة هذه الهندسة المنظمة للكون وهي الهندسة المقدسة التي ترتب وتنظم كل أشكال الوجود والحياة بداية من قرنية العين وجزيئات الحمض النووي للإنسان وفي بتلات

الازهار وكريستالات الألماس وفي فروع الاشجار والمحار البحرية والحيوانات وصولا للمجرات والمجموعات الشمسية حتى ذرات الهواء يعتمد تركيبها على ترتيب معين . ويعتمد علم الهندسة المقدسة على فهم هذه المظاهر الكونية والترتيبات الهندسية المكونة لها وتشمل نماذج هندسية ونسب رياضية محددة تُستخدم لتصميم كل شئ في الطبيعة ، لذا استخدمتها الحضارات القديمة جميعها في بناء العمارة الدينية بشكل خاص بهدف خلق مجال من الطاقة الروحية تربط الانسان بالكون من خلال تتبع نفس نسب النمط البنائي ، ومن هنا جاءت **مشكلة البحث** والتي يمكن تحديدها من خلال التساؤل التالي : ما هي مظاهر الهندسة المقدسة في فنون العمارة والزخرفة الاسلامية التي اكتسبتها جمالياتها الفنية الابداعية ؟ وذلك من خلال دراسة مفهوم الهندسة المقدسة والاشكال والترتيبات الهندسية والرياضية التي وضعها العلماء قياسا على النسب الجمالية في الطبيعة ثم تطبيق ذلك على فنون العمارة والزخرفة الاسلامية لإختبار تحقق النسب الهندسية المقدسة فيها من خلال نماذج لفنون العمارة والزخارف الاسلامية . **ويهدف البحث** لإثبات أن العمارة والزخارف الاسلامية لم تكن وليدة الصدفة بشكل عفوى او زخرفى بحت وإنما قامت على أسس هندسية ورياضية تعتمد على الهندسة المقدسة التي نظمت البناء الكونى . وتؤشر **نتائج البحث** إلى أن الفنون الاسلامية من البناء المعمارى والتشكيل الزخرفى للاسطح قامت جميعها على أسس رياضية وهندسية ذهبية النسب وهو ما منحها جمالياتها الظاهرة من خلال الراحة البصرية لها والباطنية من خلال ارتباطها هندسيا بهندسة الكون المقدسة ما يجعله متوصلا ومتناغما مع الكون حوله .

الكلمات المفتاحية :

الهندسة المقدسة - النسبة الذهبية - المستطيل الذهبى - متتالية فيبوناتشى - اللولب الذهبى - المثلث الذهبى- الفن الاسلامى - العمارة الاسلامية - الزخرفة الإسلامية.

Introduction:

The Islamic art is an expression of Islamic faith thoughts and is a reflection of it. In addition, as beauty, the eyes by which the Muslim recognizes the around world, and as meditation, the divine wisdom controlling Muslims, and as science is the Muslims' way to repopulate the earth and realizing the divine intervention. And this had been reflected on forming Islamic arts while mediating the universe around him and realizing that there is an accurate geometric system that had its relations controlled by specific ratios which were the cause of creating this great and accurate beauty and achieving balance in the universe. And as for art as it is the tangible expression of the intangible internal ideas, different forms of Islamic art like architecture and surfaces' decoration came as a direct reflection on these ideas revolving The God and not the oneself (so, the name of the artist or its sign are not mentioned in its artwork). In addition, they were all submitted to the divine ratios that God have created in the universe to achieve artistic beauty according to what these ratios achieved from nature's beauty and to follow the approach of Allah, and this is the hypothesis that the research studies to approve its validity.

Theoretical Framework:

The concept of Sacred Geometry:

Geometry is a science dealing with shapes, sizes, lines and the relations linking them. In addition, in this science, numbers are interconnected with the shape; that we cannot realize the geometric and mathematic characteristics of shapes without knowing the numeric values of them. Moreover, as for the ratios, it is the measure of two object's size. In addition, humans had realized the importance of the relations between shapes and sizes, which create the ratios,

and also had realized the main connection of geometry, ratios and numbers with nature and universe and even with the human body during latent regular patterns; creating the system that controls the universal system and nature. Everything in the universe has its own specific pattern which is its secret key, and these patterns have its role in organizing everything in the physical world .

Sacred geometry is the studies of the science of the accurate organizing patterns underlying inside all objects of the universe.

Plato began the theory of sacred geometry as he thought that God had created the universe according to an accurate and secured geometric system. This system is the main planner of the existence and the basis of all life forms of creation, so that the sacred geometry can be defined as the divine geometric arrangements of all the creatures which achieves balance and correspondence in the universe; including geometric samples and specific mathematic ratios existing inside everything in nature so, it is called geometry, as it studies, exploring and explaining the way in which the physical universal laws are arranged and explaining the accurate way achieving nature's harmony and the patterns of energy which create and unite everything, and it is called Sacred as, it studies and records these laws and the hidden systems of the creation and it is realized as holy, as The One who created it, is the Creator Allah.

This universal law to which all things have submitted to, controls our view to these objects and our realization of beauty. The ratio on which it depends on is specific specific normative; that it expresses the universal expression of the satisfied proportionality which achieves satisfaction among people and it is the golden ratio which scholars explored in the olden days realizing its relation with beauty; that everything makes eyes feel comfort and gives a feeling of a special beauty, and it must contain the golden ratio whether in its dimensions or its arrangement and harmony and it can be applied on 5 patterns:

Golden Ratio PHI:

It is called PHI as derived from the Greek letter ϕ and also it is called a golden sector or sacred proportionality and the golden ratio is estimated with 1.618033988749894848. Pythagoras and ancient Greek had proved that this ratio is visually comfort acting as one of the important standards of beauty in nature in which the ratio of the youngest to the largest equals the largest ratio to all (fig.1) and this is what makes it golden, as we cannot reach this result in any other division and the two ratios become different and this is what explains the cause of objects' harmony carrying the golden ratio and the cause of eyes' acceptance to it and feeling the beauty by it. And one of the algebraic features distinguishing the golden ratio is that when adding the number (1) to it, we get its double $1 + \phi = \phi^2$ and when deducting (1) from it, we get its root $\phi - 1 = \phi/1$.

The golden ratio is measured by a very accurate

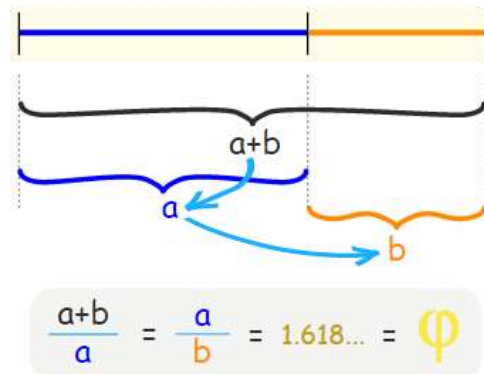


Figure1 : golden ratio



Figure 2: golden ratio mean gauge

specific tool which is called GOLDEN MEAN GAUGE (fig.2) through which the golden ratio is accurately, easily and quickly explored and measured in many forms of nature; that as long as its obtuse angle differs, it remains keeping the golden ratio and separating between its heads.

Fibonacci series:

It is a series of following numbers that every number is the result of adding the two previous numbers to it (Image), namely:

0,1,2,3,5,8,13,21,34,55. And so the series indefinitely developed. And the features of this series are created by the Mathieu, Leonardo Fibonacci so it is called by his name and the boundary distances of the numbers' location in Fibonacci's series are correspondent with the golden ratio and also the division of two sequent numbers in the series; results a very closed ratio to the golden one to reach $55/33 = 1.617$ getting the nearest number equaling the golden ratio.

Golden Rectangle:

Ancient Greek knows golden rectangle and Pythagoras mentioned it during his works. It is a rectangle divided from inside into squares, whereby the squares' sides length are serial like the numbers' serial in Fibonacci's series. Assuming that it begins with 1 unit side length square and another square with also 1 unit side length is established next to it and then, the largest square

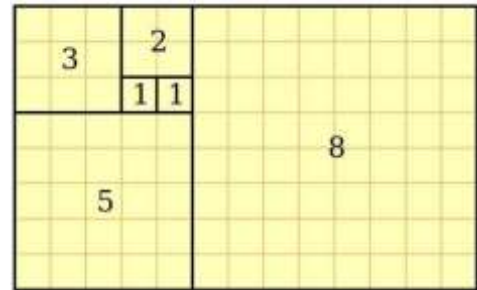


Figure3: golden rectangle

is established on these squares that its side length equals the side length of the two previous squares (2 unit 1+1) and the same process is repeated and a square is established on the previous ones, its side length equals the side length of the latest two squares (3 unit 2+1) and then establishing a square that its side length equals the side length of the latest two squares (5 unit 3+2) and indefinitely so on. Thus; we get the golden rectangle (fig.3) and on the contrary, in case of deducting the square, we get a smaller rectangle remaining to be correspondent to the main rectangle and indefinitely so on.

Golden Spiral:

We get this spiral by establishing quadrant at all the angles of the squares from which the golden rectangle is formed (fig.4) and it is not a real mathematic and geometric one as, it is formed from parts of different and together overlapped circles but, it resembles the Spiral shape which is the shape of all forms and development processes of the shapes of nature as, it develops and increases with the same golden ratio during its bending in each square. After each bend, the bending

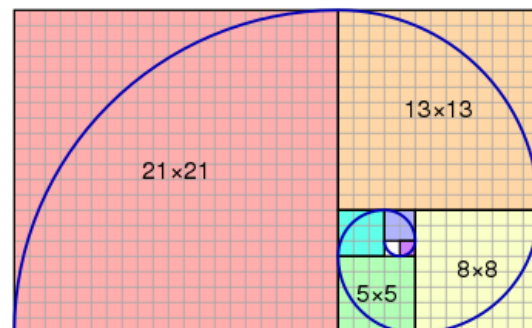


Figure 4: golden spiral

points on the spiral are 1.618 times the center and after completing a full round from the center, the ending point dimension equals $1.618 \times 8 = 6,854$ times the distance between the last bend and center .

Golden Triangle:

There is another way to get the golden ratio within establishing a two equal sides square, so that the head angle can equal 36° and its basis angles equal 72° (fig.5) and in this square, the ratio between the largest side length to the smallest one (basis) equals the golden ratio. And the square can be divided into small triangles but with the same ratios by halving one of the basis angles and we can get the golden spiral by establishing parentheses beginning from one of the two basis angles to the other angle and then, it directs into the head angle and so on⁴

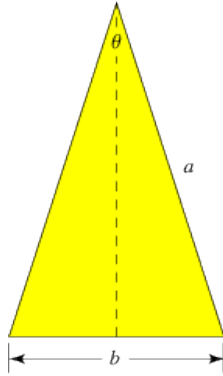


Figure 5: golden triangle



Figure 6: golden spiral formed by golden triangle





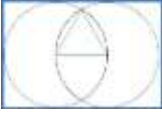



(fig6.).


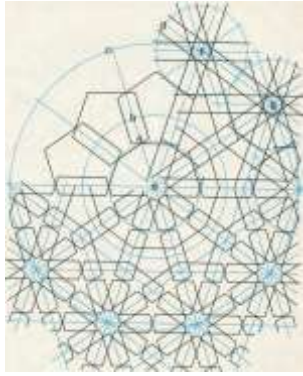
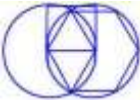
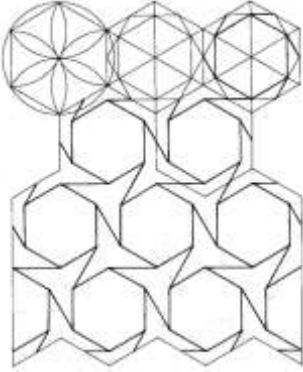



The Ratio in Quran:

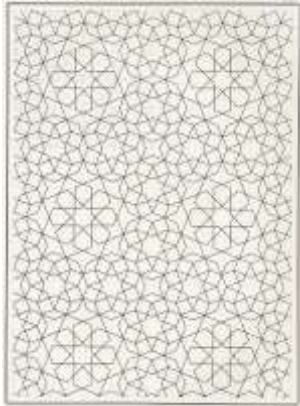
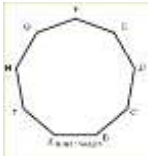

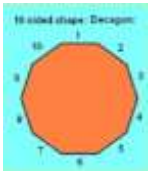

Ratio is the specific faith and the golden ratio is the perfect predestination giving all objects and shapes their balance and beauty. In addition, the Deity formed us at many positions in the Quran that he had created each thing with its specific fate and ratio. In addition, the regular universe and the balanced presence are not created in vain but they are created according to one specific system indicating the unity of the creator. God says: "Verily, we have created all things with measure " Surah Al-Qamar, verse: 49, "He to whom belongs the domination of the heavens and the earth" Surah Al-Furqan, verse: 2. And this is emphasis that the god created all things with specific ratio and fate and this is what approved in olden days by elders and recently by scholars. This accurate universal system, which is arranged according to laws, approves the unity of the creator.

Symbolism of Numbers:

Numbers play an important role in the sacred geometry. It forms the values of golden ratios, the golden ratio is the numeric value, Fibonacci series is a development and increase of numeric values and the golden triangle and the golden rectangle are together arranged and divided within specific numeric values and thus; numbers have important role in creating the golden ratio and in olden days, it was thought that every number has its own internal value distinguishing it⁸, and reflecting a specific symbolic meaning which increases the importance of some numbers that may reach the limit of holiness and also it was expressing the origin pattern of nature.

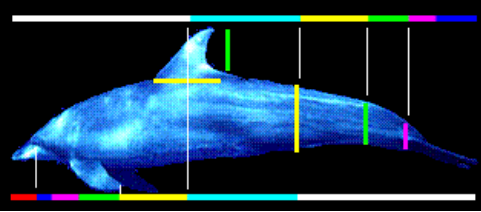
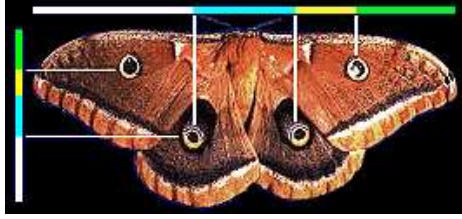
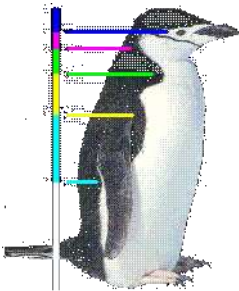
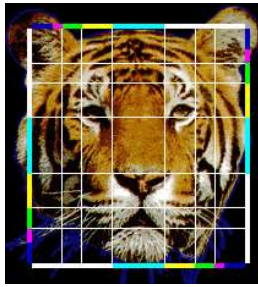

No.	Name Of Number	Related Symbol	Expressing Shape	Features of number and Its relations	The patterns of number in Islamic architecture
1	Monad	The Theism	 Circle	It is the shape from which all numbers are formed $111111111 \times 111111111 = 12345678987654321$	 dome aqsa mosque
2	Dyad	The Dualism		Balance, calmness and polarization opposite electrodes mention its source and attract each other in attempting to be integrated returning to unit status Eileen Mckusick	 minaret in Islamic architecture
3	Triad	The Trinity		All is divided into 3 parts (Beginning - middle - end) Human (Presence - soul-spirit) Life (Birth - growth - death)	 triangle in Islamic patterns
4	Tetrad	The Balance		Things standing on 4 balanced basis - Cardinal points- Seasons of year- States of matter- Elements of nature All of them are four	 kaaba the most common form of square


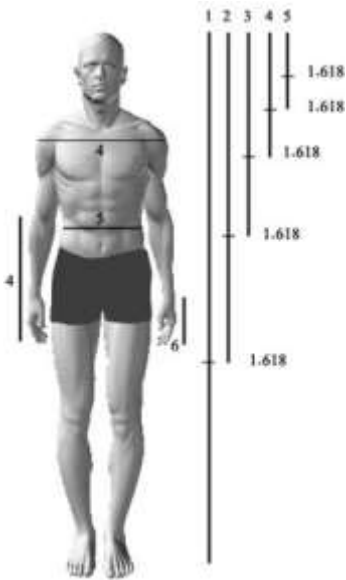
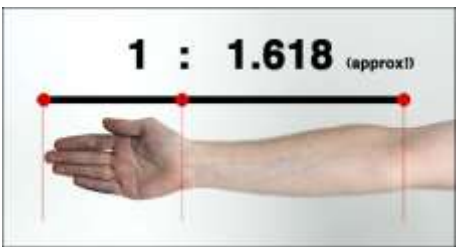
5	Pentad	The Regular quintet Highest symbol of life		<p>A shape carrying principles of renovation and surviving prayer times five Islamic principles 5 The seeds of life in the fruit are arranged in astral pattern</p>	 <p>Pentagon(the sacred figure in Islamic patterns)</p>
6	Hexad	Contrast and balance		<p>- It works at the condition, which requires strength and continuation- On of the regular shapes by which we can fill the full surface area without any space- The best use of materials for the least amount of weight as for, in beehives 1.5 ounces of 4 wax carry pounds of honey</p>	 <p>Hexagon in Islamic patterns</p>
7	Heptad	Integrity and hierarchy for distinguishing	<p>Fig.13</p> 	<p>It is not formed of a circle - Nature does not produce-Days of week are 7 -Energy release 7</p>	
8	Octad	Peace and Stability		<p>- Eight is the number passing within the seven Heavens so; some people consider it the number of the paradise. Eight angles are carrying the throne of Al-Rahman</p>	


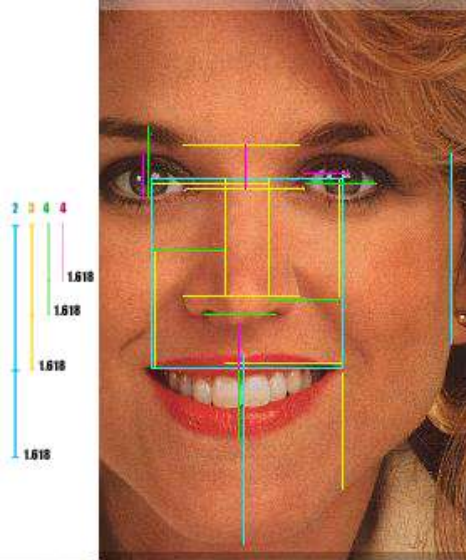
					 <p>octagon in Islamic patterns</p>
9	Ennead	The Truth		<p>9 -It acts the limits between The secular and the Endless. -The sacred trinity At the Christian Faith</p>	 <p>nonagon in Islamic patterns</p>
10	Decad	Integrity, completing the journey and returning to the radix		<p>-Coordinates all the numbers below. -Having infinite generative power.</p>	 <p>decagon in Islamic patterns</p>

sacred geometry in nature

A. The golden ratio:

Achieving samples Of the golden ratio	Description and analysis of the ratio	Image
Dolphin	Both eyes, fins And tail are existed In the golden parts of its body length, dorsal fins dimensions are golden parts (yellow and Green) the thickness of The tail is corresponded with the same golden part of the line from the head to the tail.	
Butterflies	The marks, which resembles the eyes of the butterfly, are created at the golden parts of the lines selecting its length and its side.	
Penguin	The eyes, beak, wing and all the marks of the body are created at the golden parts from its length ¹⁸	
Tiger	All the facial features of tiger are created at the golden part of lines selecting its facial length and side ¹⁸	
Bird colors	Even, the division of colors in birds is not indiscriminate but, when measuring the rates of division and colors, we found them submitted to the golden ratio.	

<p>Flowers</p>	<p>This small flower almost albino of <u>Solenopsis balearica</u>, endemic to Majorca, it also has a structure in the form and distribution of its five petals that seem designed by a mathematician. A simple outline uniting the vertices of both lateral major petals gives the first value AB and another outline uniting the vertices of both smaller petals gives to the other value CD. The simplicity and the beauty of the design are amazing. The obtained golden ratio is surprising exact¹⁷.</p>	
<p>Human body</p>	<p>Line (1) presents the length of the body, line (2) presents the golden part of line (1) presenting the distance between head's top and fingers' heads, line (3) presents the golden part of line (2) presenting the distance between the head's top and the elbow of hands, and so the middle abdomen or (the navel). Line (4) presents the golden part of line (3) presenting the interval distance between the head's top and the chest (at the upper arm level) Also it presents the width of shoulders, the length of the forearm with the palm and the length of the largest leg bone. Line (5) presents the golden part of line (4) presenting the distance between the top of head and the base of the skull. In addition, it presents the width of the abdomen.</p>	
<p>Hand</p>	<p>The hand presents a golden ratio with the forearm that ratio of the foreman for the hand also represents the golden ratio 1.618</p>	 <p style="text-align: center;">1 : 1.618 (approx)</p>

<p>Division of Hand's fingers</p>	<p>While the division of fingers from the head of the finger to the wrist basis, we realize that each part is larger than its one with a ratio equaling to the golden ratio or its dimensions are corresponded with Fibonacci 's numbers 2 / 3 / 5 / 8.</p>	
<p>Human Face</p>	<p>We will use the colored numeric lines. Each line is larger than its previous one 1.61804 times. Conversely, the represented part of the ratio 0.61804 (or presenting 61.8%) of each line equals the length of its previous one: line (2) (the blue line) forms a full square between the pupils and the external angles of the mouth. The golden part of lines number (2) the four blue lines represents the nose, the head of the nose, inside the nostrils and the two lengths of the upper lip. In addition, the blue line (2) represents the interval distance between the upper lip and down the chin and as well, the length of the ear wise the face. The yellow line (3) which presents the golden ratio forms the width of the nose, the interval distance between eyes and brows and the interval distance between the pupils and the head of the nose. Moreover, as for the green line (4) which presents the golden ratio of line (3), it represents the width of the eyes covering the vertical line near the pupils, which represents the distance between the lower eyelid and the eyebrows. In addition, it forms the distance between the nostrils. Moreover, as for the purple line (5) which represents the golden ratio of line (4), it forms the distance between the upper lip and down nose. In addition, it forms many other dimensions in the eyes.</p>	

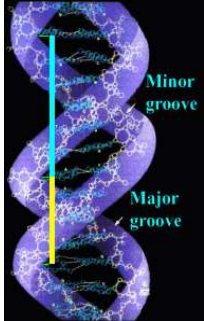


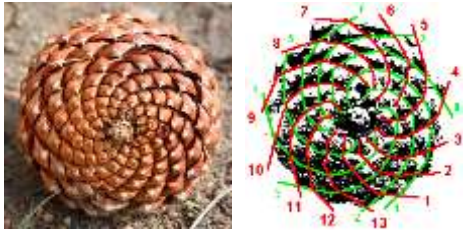
A. Fibonacci sequence:

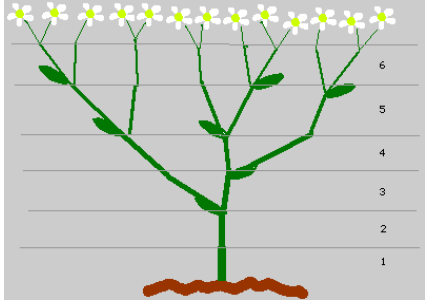
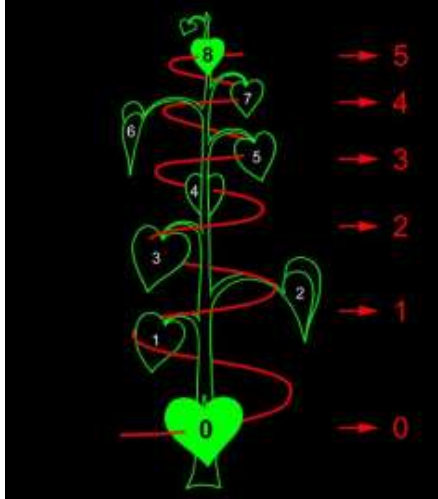
Fibonacci sequence can be found in various shapes in nature, especially in the composition of plants' leaves, seeds and petals. It exists in three shapes in nature:

1-Vertical: As in the growth of plants' leaves, they grow upwards climbing up the stem vertically resembling Fibonacci sequence.

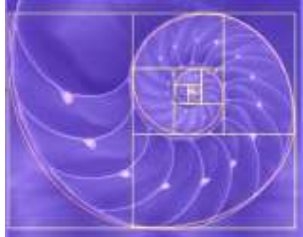
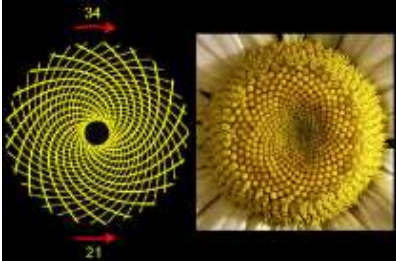
2-Horizontal: As in sunflowers' seeds, they grow horizontally.





3- Conical or circular: As in pines' fruits, they resemble Fibonacci sequence by forming a spiral path.

Proof of the sequence in nature	Analysis and description	Image
DNA	The measurements of the DNA resembles Fibonacci sequence, the length of 34 Angstrom to the width of 21 Angstrom of a whole annulations of a whole double spiral, almost equals the golden ratio.(reference Mad Al Gamal P17)	
Anemone Flower	It has 5 Petals which resemble Fibonacci sequence in growth, every petal is 0.618034 in order to rotate in a circle be best exposed to the sun.	
Sun flower seeds	Sunflower seeds are produced in the center of the flower and they grow outwards resembling Fibonacci sequence, and it is the best example of the escalating patterns. Sometimes the flower gets filled with the tips of the seeds till they get to 144 seeds or more, when counting these spirals we found that it equals to Fibonacci number ²¹ .	
pine cone	The tips of the seeds are arranged in a spiral pattern on the conical body of the pine, each cone consist of two pairs of spirals that grow in two opposite ways, and we may notice that every group of a spiral path equals two adjoining numbers in Fibonacci sequence.(there are 8 sets of clockwise spirals while there are 13 sets of counter-clockwise spirals ²⁰ .)	

<p>Tree branches</p>	<p>Fibonacci sequence can be found in the pattern of tree branches. The main trunk grows and forms a branch, the branch creates two buds, and the buds grow to form two branches and the two branches form more branches and this pattern repeats from every new branch²⁰.</p>	
<p>Tree leaves</p>	<p>The growth of tree leaves is noticed to resemble Fibonacci sequence, it grows upwards trailing on the stem, if we assumed that the leaf num1 is the starting point, so to get to the leaf that is directly above it we need to get through 5 revolutions that in each one 8 leaves grow spirally around the stem. By dividing 8(leaves number) and 5(revolutions number) we get =1.6 which is the golden ratio²¹.</p>	

A. The Golden Rectangle and The Golden Spiral: The golden spiral can be found in every shape and growth movements in seashells, fruits, seeds arrangements, human's ears, even the galaxies, and the arrangements of human's DNA, as if this order has been created in creatures genes to prove the Oneness of the Almighty.

Example of the Golden spiral in nature	The analysis and description	picture
<p>Seashells</p>	<p>It is the greatest example that resembles the Golden Spiral, the spiral growth of shells starts from inside out according to the Golden spiral.</p>	
<p>Sunflowers</p>	<p>Two groups of Spirals are found inside the flower, one of them moves clockwise from the center and the other moves counter-clockwise, the number of both tracks is equal to two consecutive digits in Fibonacci sequence²¹.</p>	

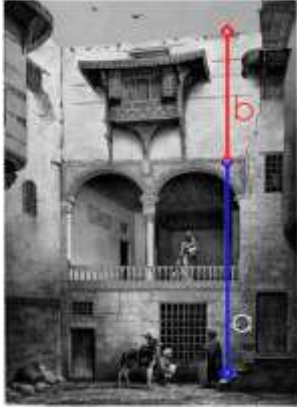

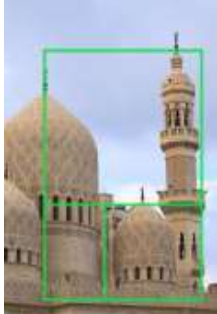
Cactus	The leaves of cactus grow from inside out in Spiral that matches the golden spiral and the number of leaves in each Spiral and the one next to it equal two adjoining numbers in Fibonacci sequence.	
Humans Ears	The constructive shape of human's ears resembles Fibonacci sequence.	
Hurricanes	The hurricanes resemble Fibonacci sequence in its growth and movement ²¹ .	
Galaxies	Due to the speed of rotation in its field, it varies with the distance from the center, so the radial armaments of the galaxies must become curved while the galaxies spin, so it is not surprising to find them subject to the pattern of the golden snail ²¹ .	

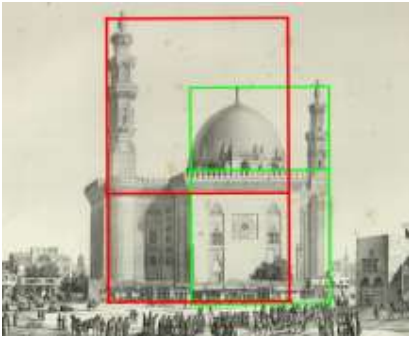
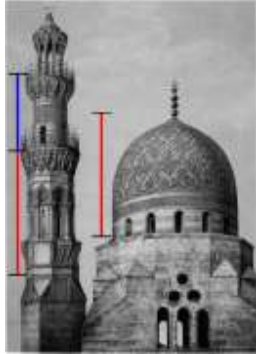
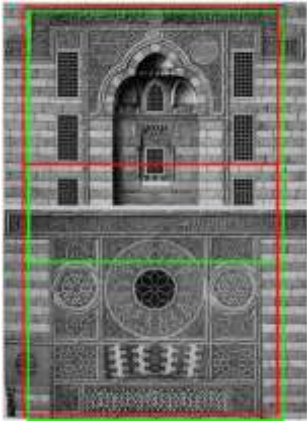
The sacred geometry in Islamic Architecture:

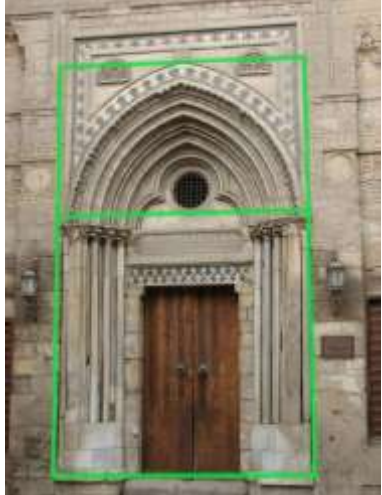
Qur'an and belief are the main foundations of Islamic thought, because ratio is God's law to create his creature, engineering is the order that God used in building the universe, Muslim's belief is to carefully and deeply contemplate God's creatures and verses, so every work by God should follow this sacred engineering, its effect reflects on every art created, starting from decorative dishes to architecture. Islamic arts are architecture based at the first place, because every detail was made by engineering and mathematical laws, because it reflected the Islamic belief in every sense, and because it followed engineering ratios, as what we are going to discuss in the upcoming analysis, all these elements gave spiritual, beautiful values and symbolism that made the Islamic architecture and arts at that sacred status.



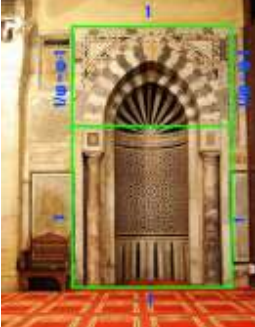
• *Analysis of examples of Islamic architecture according to sacred geometry laws:*


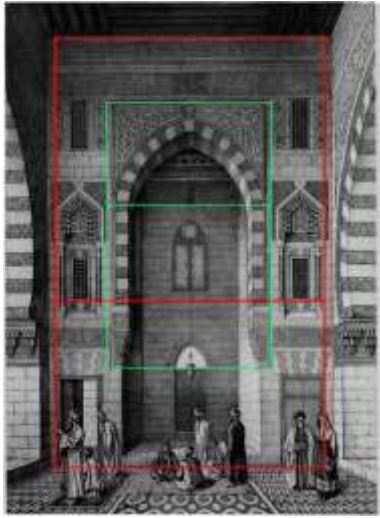
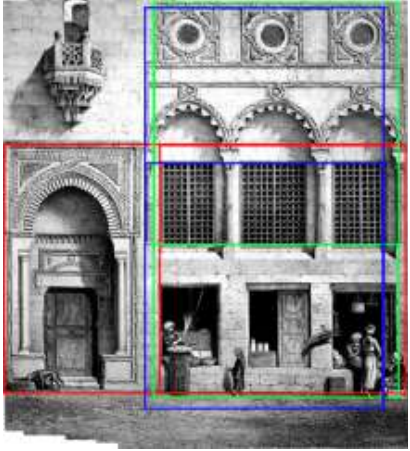
The next schedule shows some examples of Egyptian architecture, with analysis and description of its engineering according to the sacred engineering and its various patterns, to stand as proofs to the existence of the Golden ratio.

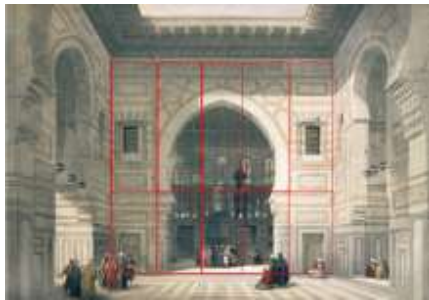
The Sample	The pattern In measurement	Description and analysis	Image
House of the 17th century (unknown)	Golden Ratio PHI	The ab line represents the height of the house, and part a represents the golden section of the golden line of line (ab) for the distance from the ground to the roof of the Iwan “large sitting room” and part b represents the golden section of line ab of the upper margin of the wall containing the Mashrabiya.	
El Morsi Abu El Abbas Mosque (Alexandria)	The Golden rectangle	The facade of the mosque (entrance) is subject to its measurements of the golden ratio, where the part starting from the ground and up to the neck of the rotation of the triangular arch is the largest section of the golden rectangle, and the part from neck of the arch up to the the ending of the wall represents the smallest section of it . Likewise the part starting from the ground up to the starting of the arch represents the smallest section of the second golden rectangle .	
Dome and Minaret of Al – Morsi Abu Al Abbas Mosque	The Golden rectangle	The smaller golden section of the rectangle represents the height of the smaller dome and its larger golden section represented by the larger dome and the upper part of the minaret.	

<p>Sultan Hassan Mosque in Cairo</p>	<p>The Golden rectangle</p>	<p>The height of the minarets is consistent with the layout of the mosque's facade. The height of the taller minaret with the height of the wall of the façade represents a golden rectangle, The distance from the ground to the end of the wall represents the smaller section and from the end of the wall to the height of the minaret (without the crescent) represents the bigger section. likewise, the smaller minaret with the dome represents another golden rectangle where the height of the wall represents the larger golden section of the rectangle and the dome represents the smaller golden section of the golden rectangle and the length of the minaret.</p>	
<p>Dome and Minaret of Khairat Bey 16th century</p>	<p>Golden Ratio</p>	<p>The line (blue / red) represents the upper decorated distance of the minaret. The red line represents the golden section of the line (blue / red) which is the lower distance of the minaret and represents the height of the dome</p>	
<p>A wall (islamic architecture in cairo- unknown)</p>	<p>The Golden rectangle</p>	<p>The mural decoration is governed by two golden rectangles. The largest golden section represents the distance between the ground and the second window, right and left, passing through the middle of the window in the middle of the mural, and the smaller section represents the remaining distance .in the other golden rectangle , the smaller section represents the distance from the ground up to the ending of the two "left and right" circles, and the bigger section represents the remainig distance up to the ceiling.</p>	

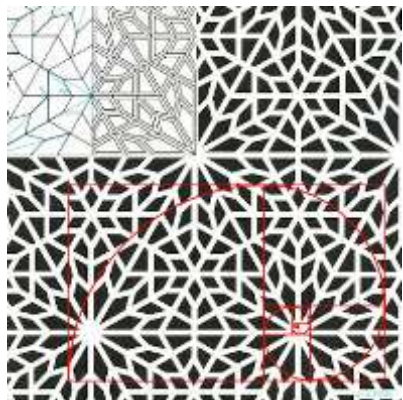
<p>Al-Nasser Mohammed Mosque (Cairo)</p>	<p>The Golden rectangle</p>	<p>Where the largest golden section in the rectangle is the horizontal distance from the first column based of the building until the pillar based the next decade and the smaller gold section represents the distance between the columns, and the height of the rectangle that corresponds to the height of the arch.</p>	
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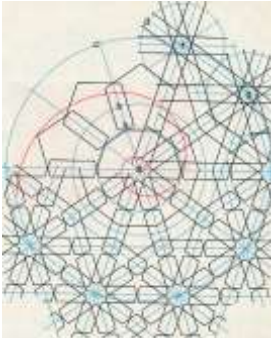

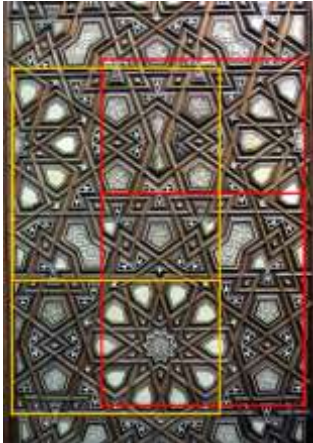
<p>Ibn Tulun Mosque (Cairo)</p>	<p>The Golden rectangle</p>	<p>Where the largest golden section in the rectangle is the horizontal distance from the first column on the base of the building until the pillar based the next decade and the smaller gold section represents the distance between the columns, and the height of the rectangle that corresponds to the height of the arch</p>	
<p>Minaret of the great mosque of samarra</p>	<p>The Golden Spiral</p>	<p>It is the greatest example that resembles the Golden Spiral in Islamic architecture, the spiral growth of stairs starts from inside out according to the Golden spiral.</p>	
<p>Mihrab “a niche in a mosque directed to the kiblah” of Al-Azhar mosque</p>	<p>The golden rectangle</p>	<p>The proportion of the prayer niche Matches to the ratio of the golden rectangle, the golden section of the largest distance from the ground until the beginning of the decade, and the smaller gold section represents the distance from the first decade to the end of the top.</p>	



<p>Mosque of Al-Ashraf Barsby</p>	<p>The golden rectangle</p>	<p>The partition of the prayer niche wall (mihrab) Matches to the proportions of the golden rectangle, the larger golden section of the rectangle is the distance from the ground to the beginning of the window. The smaller golden one represents the distance from the first window to the end of the window. It also includes within the lunar top Mihrab (round window)</p>	
<p>Mosque of Qaitbay</p>	<p>The golden rectangle</p>	<p>The division of the wall is subject to several golden ratios, including the golden red rectangle, which represents the golden section, which is the distance from the ground to the beginning of the window. The golden section represents the distance from the beginning of the window to the ceiling, and there is another golden rectangle subject to the division of the building itself, From the beginning of the Muqarnasat " They are from a group of vaulted niches, hanging or resting on top of each other in layers or in a nondescript row and are usually graded symmetrically." Until the first rotation of the building and the smaller gold section represents the distance from the first rotation of the building to its end.</p>	
<p>Unknown interface</p>	<p>The golden rectangle</p>	<p>The division wall is completely subject for the gold ratio, the first golden rectangle in blue (vertical), where the largest golden section of the rectangle is the distance from the ground to the beginning of the arch, above windows and the end of the entrance door's arch. The smaller golden section of the rectangle represents the distance from the beginning of arches to the end of the wall., and the second golden rectangle in red (horizontal) the larger golden section of it represents the distance "from the right" from beginning of the arches to their</p>	

		end "at left" and the smaller golden part represents the distance which contains the door. green(vertical), the largest golden section represents distance from the top of the wall to the base of the columns of the arches and the smallest golden part represents the distance from the base of columns to the ground.	
Sultan Hassan Mosque	Golden rectangle , Fibonacci sequence	The wall layout is subject to the golden ratio. The wall represents the golden rectangle (vertically). The golden section represents the distance from the ceiling to the beginning of the arch. The smaller section represents the distance from the beginning of the arch to the ground. The ratio of the wall to the opened area is 2: 3 Where, the wall is divided vertically into 5 equal units occupied by two units on the right and left of the wall and 3 units in the middle for the opened area, so that the ratio is 2: 3 which corresponds to the numbers in a Fibonacci sequence.	

• *Analysis of patterns of Islamic ornament according to the laws of sacred geometry :*

The Sample	The pattern In measurement	Description and analysis	Image
Stellar Geometric motifs	The rectangle and the gold Spiral	One of the most important decorations that characterized the Islamic art, which strongly reflect the concept of sacred architecture, is that although it is based on purely engineering and compulsory accounts, it is a whole within which symbolic meanings reflected the Islamic thought and vision of the absolute God that has no limits and no end, Hence, the status of sanctity has	

		<p>been achieved, We note that the beginning of the gold spiral from the center of the star (which symbolizes the Creator) in outward direction and its growth to include life and the universe.</p>	
<p>Stellar decorations based on the pentagon</p>	<p>The Golden Spiral</p>	<p>The decorative pattern consists of 10 pentagonal shapes that wrap around circles (a) and (b), the ratio between diagonal and golden ratio and the relative relationship between the five shapes. These circles are determined by dividing the ribs of the pentacles by circle (b), then the decorative pattern extends to a larger circle c), which has a radius of twice the circle (b) and so on (reference: pattern in Islamic art)</p>	
<p>Stellar Geometric motifs</p>	<p>The Golden Spiral</p>	<p>This ornament pattern is made up of a central circle which is the source of all the other shapes. We note that the growth and spread of the decoration around the center is consistent with the golden Spiral.</p>	
<p>Decorations of wooden door of the mosque Rifai</p>	<p>Golden rectangle</p>	<p>The golden ratio in the parts of the decorative pattern is represented by the right golden rectangle, which is the smaller golden section of which is half a gear (half star) on the right, and on the left is the distance between the two bucklers which contain the surrounding geometrical ornaments " Al-kendas". The smaller is the buckler (the star) and the larger gold section represents half the buckler and the surrounding.</p>	

<p>A door of Al Moayyed Mosque</p>	<p>The Golden Spiral</p>	<p>Stellar decoration is one of the most common patterns of growth and outward spread. We note that its growth matches with the gold Spiral in order to prove the validity of the golden ratio.</p>	
<p>Part of the Al-Hussein Mosque platform (now in the Islamic Museum)</p>	<p>Golden rectangle</p>	<p>The Golden Ratio is represented by the creation of the design parts within the golden rectangles, the larger golden section represents the hexagonal shape, the smaller golden section represents the star shape which is the middle of the design and the intersection of the two golden rectangles determine exactly the horizontal lines of the six-pointed star. In the upper strip, Vegetation is also subject to a golden division that determines the beginnings and ends of the letters horizontally and vertically.</p>	

Conclusion:

- 1- All forms of life are governed by fixed and specific laws which are regulated and this is clearly shown by the most precise unit of human being which is DNA, even the galaxies in the sky are all guided by a unified universe that indicates the unity of the Creator.
- 2- The Muslim artist was influenced by this sacred geometry and reflected in many works of art (in addition to his use of other proportions), where he took care of engineering and proportions in the design of parts which is placed in arrangements according to the engineering planning accurate in most cases to the golden ratio in particular.

Recommendations:

- 1 - Interest in teaching the golden ratio in the Islamic arts (many) in various fields for the students of art as authentic artistic models to achieve the golden ratio, especially that we have a huge savings of Islamic arts, which is subject to this ratio.
- 2 - Taking advantage of the golden ratio in contemporary designs to achieve comfortable beauty ratios .

References:

- 1- Elkhaleel , Abdel wahed . "golden ratio is the source of beauty and inspiration" . *Journal of Science and Technology* ,year : 29, Volume: 114 (2015) p.10:14 .
- 2- Elkhaleel , Abdel wahed . "tides of beauty and myth". *Journal of Science and Technology* -year : 29, Volume: 114 (2015) p. 16 : 21 .
- 3- Bemanian, M.R. Ekhvat, H., Bagaie, P. *The use of geometry and proportions in architecture*. Tehran . Hele publication , (2011) (p.24).
- 4- Esmaili Sangari, H. *The Role of Sacred Architecture from Concept to Application (Case Study: Tabriz Historic Bazaar Complex Religious Spaces* . in the Proceedings of the National Conference of Islamic architecture and urbanism, Tabriz Islamic Art University, Tabriz (2013) . p.192.
- 5- Kenza, Boussora , and Said Mazouz. " The Use of the Golden Section in the Great Mosque at Kairouan" . *Nexus Network Journal - Springer-* Volume 6, Issue 1, (2004) pp 7–16 .
- 6-Gyorgy Doczi . *The Power of Limits: Proportional Harmonies in Nature, Art, and Architecture*. Boston . shambhala publication Inc. , (2005).
- 7- M. Hejazi . *Sacred geometry in nature and Persian architecture* . History of Science, Volume :6- Issue2 (2008).
- 8- Ganizadehhesar, Nazli, and Nasim Najaf gollpour kalantari , Mortaza Ahmadi "Study of Sacred Geometry in Islamic Architecture". *Cumhuriyet University Faculty of Science Science Journal (CSJ)*, Vol. 36, No: 3 Special Issue (2015) p.3805.
- 9-Robert Lawlor . *Sacred Geometry - Philosophy and Practice* . Thames & Hudson Ltd, London (2002).
- 10- Safa E. Hanafy . *The role of sacred geometry in enhancing the appearance of industrial design products*. volume : 6, Issue 1 (2016) p.194,195.
- 11- Handayani, Tri, and Didit Widiatmoko Soewardikoen . *Exploration of Golden Section Proportion Potency in* . *Advances in Economics, Business and Management Research (AEBMR)*, volume 41- 4th Bandung Creative Movement International Conference on Creative Industries (2017).
- 12- Qahtan, Mahmoud, "Golden Ratio". mahmoudqahtan.com
<https://mahmoudqahtan.com/%D8%A7%D9%84%D9%86%D8%B3%D8%A8%D8%A9-%D8%A7%D9%84%D8%B0%D9%87%D8%A8%D9%8A%D8%A9-golden-ratio/>(accessed February 7, 2013)
- 13- Nick Seewald . " The myth of the golden ratio" . goldenrationmyth.weebly.com
<https://goldenrationmyth.weebly.com/geometric-constructions-involving-phi.html>

- 14- Gary Meisner. " Tiling in 5-fold symmetry was thought impossible".goldennumber.net
<https://www.goldennumber.net/penrose-tiling/>.(accessed May 13, 2012).
- 15- <https://www.mathsisfun.com/numbers/golden-ratio.html>
- 16- Gary Meisner." Phi and Fibonacci in Kepler and Golden Triangles".goldennumber.net
<https://www.goldennumber.net/triangles/> (accessed May 13, 2012).
- 17- Juan Bibiloni . "Structural genetics: the Golden Ratio Phi (ϕ). mundani-garden.blogspot.com
<http://mundani-garden.blogspot.com/2011/08/structural-genetics-golden-ratio-phi.html>
(accessed August 13, 2011)
- 18- Gary Meisner. "Meisner Beauty Guide for Golden Ratio Facial Analysis".
goldennumber.net
<https://www.goldennumber.net/category/design/>(accessed October 31, 2016)