

The golden ratio: importance



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The great architect of age and every culture, the basis of which is Golden Ratio. Thesis statement: What is the Golden Ratio? How can one number be so important that countless historical figures have spent many years of their lives studying it and proving its existence? And why is it still so relevant in today's design and architecture?

Introduction

What is the most satisfying proportion in today design? The Greeks thought they knew. Their temples were designed according to certain rules relating to “ the golden section”. (Which is what we, layman, know as the Divine Proportion, the Golden Proportion, the Golden Number or even the Golden hat Mean.) In the 13th century, Fibonnaci, an Italian mathematician, put it all down on paper. He said, “‘ the golden section’ or perfect proportion was 0.618034 to 1 (about 5 to 8).” The Parthenon (a temple in the Athenian Acropolis that the Greeks built, dedicated to the Greek goddess Athena) fits into Fibonnaci's Golden rectangle. Incidentally, so do the pyramids at Giza. Does this make the Golden proportion a necessary rule to follow in design?

In the 16th century, Leonardo Da Vinci wrote a book on geometric recreations called Divine Proportion. In 1948 Le Corbusier also wrote a book on mathematical proportioning. Others who have benefited this ratio are biologists, artists, psychologists and even mystics have pondered and debated on the basis of ubiquity and appeal. It is fair to say that the Golden Ratio has inspired thinkers of all disciplines like no other numbers in the history of mathematics.

Throughout the generations, many architects have also searched for the golden rule of design, thinking that it is that of the Golden Ratio. However, their search is far from over. This is because mathematics alone will not tell you what the most eye-pleasing proportion for a building's structure is. Proportion must be generically correct and determined by the nature of the material. In other words, it is one thing for stone, another for concrete, and something else for steel. This, we would discuss further in another segment. Present technology has also given architects and engineers unlimited range to compose new forms of design and exciting spaces.

My stand is that the Golden Ratio is an important aspect in designing a building but it is not the most crucial. Besides having proportion in a building, functionality is also important. A creative design through the creative intuition of a designer will make the building outstanding.

History Background – Renaissance Period

The Golden Ratio is related to many things in the world today, not only during the times of Renaissance, Le Corbusier and Alberti. It exists in architecture, art, music, design and even fashion.

Since Renaissance, many artists and architects have proportioned their works to the Golden Ratio, especially in the form of golden rectangle, in which the ratio of the longer side to the shorter in the Golden Ratio, causing this proportion to be aesthetically pleasing. Mathematicians have studied this because of its unique and interesting properties applying it to geometry.

Since then, it has opened up doors for me how I view design and architecture and how it balances harmony to architecture design in this modern world.

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B Body

The Golden Ratio in the Past

Firstly, let us consider what the ancients were trying to achieve by including the Golden Proportion in their design.

Taking the building of the Parthenon temple as an example, the Greeks have shown a clear example of proportioned Golden Ratio and design, with it being circumscribed by golden rectangles. Some scholars, however, denied that the Greeks had any aesthetic association with Golden Ratio. It could have been just pure sense of good proportion by the architects at that time.

Making a building pleasing to one's eyes and creating harmony in space was the main objective. The Greeks simply wanted to achieve perfection that pleases their God, Athena.

The Parthenon's facade is, or? Unlikely I feel, as it is seen from the pictures, the measurements and the superimpose golden rectangles, these choices are so well made that there must be some work of the mathematical calculations to derive such proportioned structure of a building.

They feel that it was not until Euclid that mathematical properties were studied. Before Elements (308BC) the Greek merely regarded the number merely as an interesting irrational numbers, with regular pentagons and decagons and dodecahedron (a regular polyhedron) and regular pentagons.

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But one thing for sure, it was the Euclid where it is showed how to calculate the value. Vitruvius (a Roman writer, architect and engineer) discussed proportions where it can be expressed in whole numbers, as opposed to irrational proportions.

Secondly, Are modern designers concerned with the issue of Golden Ratio to architectural design? Whether they still apply Golden Ratio?

Le Corbusier is said to have contributed to many modern international style architecture, centering on harmony and proportion. Its faith in the mathematical order was closely bound by the Golden Ratio and the Fibonacci series. He uses the Golden Ratio in his modulator system for the scale of architectural proportion. He saw this system as a continuation of the long tradition of Vitruvius, and others who used the proportions of the human body, to improve the appearance and function of architecture.

In addition to Golden Ratio, Le Corbusier based the system on human measurements, Fibonacci numbers and the double unit. He took Leonardo's suggestion of the Great Ratio in human proportions to an extreme, he sectioned his model human body's height at the navel with the two sections in the Golden Ratio, then subdivided those sections in Golden Ratio at the knees and throat; he used these Golden Ratio proportions in the Modulor system. The Villa Stein in Garches exemplified the Modular system. The Villa's rectangular ground, elevation and inner structure closely approximate golden rectangles.

Thirdly, Fractal Dimensions in Modern Architecture

Recently, fractal dimensions have been calculated to be used frequently for Frank Lloyd Wright's and Le Corbusier's buildings. It can be found that both architects use the method of increasingly smaller rectangular grids. Frank Lloyd Wright's buildings display a self-similar characteristic over a wide range of scales (far and spaced versus micro small sizes), so those buildings are intrinsically fractal. However for this specific project, Wright was following the brilliant example of his teacher, Louis Sullivan.

By contrast, Le Corbusier's architecture displays a characteristic over only two or three of the largest scales. In more detail, Le Corbusier's architecture is flat and straight, and therefore has no fractal qualities.

“ A fractal dimension between one and two characterizes a design that has an infinite number of self-similar levels of scale, whereas the fractal dimension of Le Corbusier's buildings immediately drops to one.” (Bovill, 1996. Salingaros, 1999.)

Golden Ratio has also proven in the Art and Nature

Leonardo da Vinci's illustrated yet another divine proportion in the infamous painting of Mona Lisa. Other equally well known painting which has made use of the Golden Ratio is The Sacrament of the Last Supper by Salvador Dali.

The Golden Ratio is expressed in the arrangement of branches along the stems of plants and of veins in leaves and even to the skeletons of animals including their veins and nerves, to the proportions of chemical compounds and the geometry of crystals, to the use of proportion in artistic endeavours.

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From this, the Golden Ratio has become a universal law in strive to create completeness and beauty, with both nature and art, in structure, forms and proportions, organic and inorganic, in the human form.

According to Volkmar Weiss and Harold Weiss the Golden Ratio also affects the clock cycle of brain waves, known as psychometric data.

Golden Ratio is Relevance in Present Times

Modernising the Traditional Intimate Relationship Between Architecture and Mathematics

The traditional intimate relationship between architecture and mathematics has changed in the 20th century.

“ Architecture students no longer need to have a mathematical background” according to the article Architecture, Patterns and Mathematics by Nikos Salingaros.

It may be promoting an anti-mathematical mindset. Mathematics is a science of patterns, the presence or absence of patterns in our surroundings influences how easily one grasp the concepts that rely on patterns. However, it has been seen that an increase in technological advances, rather especially in the area of environmental factors, has made mathematics almost redundant in architecture.

Environmental psychologists know that our surroundings influence the way we think, so if we are raised in an anti-mathematical environment, then we would deem to subscribe more human qualities. This is not an argument

about preferences or styles, it concerns more about a trained functionality of the human mind!

An example to illustrate the meaning of functionality in the human mind is made by Christopher Alexander where:

“ the need for lights from two sides of a room; a well-defined entrance; interaction of footpaths and car roads; hierarchy of privacy in different rooms of a house and etc. It speaks about specific building types, about building blocks that can be combined in an infinite number of ways.”

This implies a more mathematical and combinatoric approach to design in general. Alexandrine patterns represent solutions which repeat itself in time and space, thus relating to visual patterns transforming into other dimensions.

A new concept: Organic Architecture

In recent years, there has been a shift in architecture looking away from Golden Ratio to other ways in which design can still have a sense of proportion by looking at nature for inspiration; the term given is Organic Architecture.

The term organic architecture was coined by the famous modern architect, Frank Lloyd Wright (1867-1959), though never well expressed by his cryptic style of writing:

“ So here I stand before you preaching organic architecture: declaring organic architecture to be the modern ideal and the teaching so much needed if we are to see the whole of life, and to now serve the whole of life,

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holding no traditions essential to the great TRADITION. Nor cherishing any preconceived form fixing upon us either past, present or future, but instead exalting the simple laws of common sense or of super-sense if you prefer determining form by way of the nature of materials...” – Frank Lloyd Wright, written in 1939.

While Organic Architecture does describe some form of individuality, it also expresses our need to connect the designs, we create, to Nature.

Using Nature as a fundamental for design, from there a building or design must grow, as Nature grows, from the inside out. Many architects design their buildings as that similar to a shell and force their way inside. Nature grows from the idea of a seed and reaches out to its surroundings. A building thus, is akin to an organism and mirrors the beauty and complexity of Nature.

Where the Golden Ratio Fits In

However, in the research that I have done on this topic, many of the historic scholars who devoted their entire lives to studying the Golden Ratio has always studied nature for inspiration and they derived the Golden Ratio from nature itself. Modern architects who claim to move away from the Golden Ratio as it is too conformist and look towards nature for their inspiration for proportion instead still end up following the Golden Ratio as it was from studying nature that led to the discovery of Golden Ratio. Hence, the continuing relevance of Golden Ratio in today’s architecture.

How the Golden Ratio is evident in our everyday lives

The Golden Ratio seen in Music

Rhythm is everywhere in nature, at every scale from cosmic phenomena to the oscillations of atoms. Our every cell has its own clock, governing its own repetitive rhythms. Time itself, once measured by the motion of earth, sun and stars, is now defined, less memorably, as 9, 192, 631, 770 oscillations of a single atom of an obscure metal. At the scale of the biosphere, the fidelity of replication in the genetic system is such that no more than about 200 errors are made in copying the 300 million bases strung into the chromosomes that hoard the design of our bodies. Without those errors, however, there could be no change and so no evolution.

With this in mind, we shall now look at how rhythm ties in with the Golden Ratio.

Much of the rhythm and movement and design of our bodies and normal everyday life experiences all tie in with the Golden Ratio, how we perceive an object and whether we find it pleasing all goes back to the Golden Ratio. Because it is the one of the universal constants that allow for the interactions between all things on earth, it continues to hold relevance in our lives, regardless of the advancements in technology, which in fact is actually discovering more and more how life and design is so intimately associated with the Golden Ratio.

Architectural evidence of the Golden Ratio

Take a look at modern architecture and you will soon realize that the last decades have produced an increasing number of buildings with exotic

shapes. Of course, also in earlier times the design of buildings has been influenced by mathematical ideas regarding, for instance, symmetry. Both historical and modern developments show that mathematics can play an important role, ranging from appropriate descriptions of designs to guiding the designer's intuition.

C Case study

Case Study One: Republic Poly Technology of Singapore by Fumihiko Maki

Fumihiko Maki designed the new campus attempting to preserve the green qualities and the topography of the original site introducing landscape elements that contrast with the natural wilderness and strengthen the sense of place based on Golden Ratio.

Case Study Two: AL Mukminin Mosque In Jurong East by Forum Architects built in 1987

The adoption of the Fibonacci sequence as a design generator is the intriguing concept of this Mosque, a strong arithmetic pattern. The architects involved with questions of context and the sense of harmony is gathered from the aspiration.

Case Study Three: Palladio's Villa Rotunda.

The Villa Rotonda design is completely symmetrical on all axes under a modern terminology, including diagonals.

Case Study Four: Taj Mahal

Taj Mahal in India contains the golden ratio in its design and it was completed in 1648.

Case Study Five: CN Tower in Toronto

The CN Tower in Toronto, the tallest tower structure in the world, has also has golden ratio in its design. 342 meters was the ratio of observation deck and total height of 553.33 is 0.618 or phi, the reciprocal of Phi!

Case Study Six: California Polytechnic State University

The College of Engineering was also designed based on the Fibonacci number

What I have perceived until this moment

In my analysis, Golden Ratio forms the basis of understanding of architecture, however it is not the entirety. Because form follows function, function plays an important part of the architectural design because without understanding the functionality of form, it is not possible to develop a building of good use, for example a good architect must be able to understand the utility of function.

For example, the architect must know how many rooms a house needs, whether a swimming pool is required or a badminton court needed. After a form is selected and function must go beyond the concerns of biotechnical materialism.

The creative architects must go beyond utility & technical knowledge to an awareness of experiential associations and symbolic meanings that lies behind the visible form. Beauty in design is not guaranteed when all of the above is satisfied. Some intuition is required by the architect and an outstanding design depends also in skill and intuition with functionality.

Therefore, the great architect of age and every culture, the basis of which is mathematical.

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