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Measuring Complexity in the Artistic Representation of the Architecture of Balkrishna Doshi

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Abstract

Besides his architectural works, Indian architect Balkrishna Vithaldas Doshi is also renowned for expressing his ideas through his paintings. Inspired by Indian-Mughal miniatures, these paintings present his architectural works by depicting an idea so prevalent in Indian culture as well as in his works: complexity. To investigate this notion in a quantitatively measurable manner, this paper investigates one of the architect's most significant works, Sangath, depicted both in Doshi's painting and in the form of conventional orthographic drawings, using a comparative fractal dimension analysis. The result proves that the fractal dimension of Doshi's painting of Sangath is significantly higher than those of the orthographic drawings showing the building's exterior: block plan, front elevation, and right elevation. The conclusion suggests that Doshi's painting is capable of presenting an idea of complexity more prominently than conventional architectural drawings.

Keywords: *Balkrishna Doshi; fractal analysis; fractal dimension; Indian-Mughal miniature paintings; visual complexity*

Introduction

As indicated by a note, he wrote in 1972 stating that "[a]rt plays a great part in [the] environment" (Curtis, 1988, p. 29), art also plays an equally great part in Architect Balkrishna Vithaldas Doshi's life. On numerous occasions, the architect drew inspiration for his architectural works from art and artistic works; on the other hand, he also expressed his ideas and depicted his architecture through artistic works, particularly paintings. Inspired by Indian-Mughal miniatures, Doshi's paintings capture his architectural works in a way unique to him, presenting a lot of nuances— nuances that can be summarized as *complexity*. Indeed, this very style of Doshi's in depicting his works might be a medium that is better than the more conventional modes of architectural representation in presenting this idea of complexity.

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However, this notion is formulated almost totally in a qualitative manner from the descriptive and interpretive commentaries in Doshi's writings as well as those of the critics. Therefore, there is a possibility to evaluate this notion in a more quantitative, mathematically measurable manner. One alternative method for such a measurement is fractal dimension analysis. Fractal dimension is a dimension with a non-integer value and used to measure visual complexity. Since the first attempts at its formulation (Mandelbrot, 1982; Voss, 1986), fractal dimension analysis has been applied in various fields, including art and design.

This paper presents the results of the quantitative measurement of the visual complexity of one of Balkrishna Doshi's paintings, namely his painting of Sangath (his architecture studio and the office of Vastu-Shilpa Foundation), and the conventional architectural drawings of the same building. By calculating the fractal dimensions of the painting and the drawings comparatively, the notion of a more prominent presence of complexity in Doshi's painting can be tested.

This paper commences with a brief introduction to Balkrishna Doshi, his architecture, and his interest in Indian-Mughal miniature paintings, followed by a description of Sangath, both as an architectural work and an object of a miniature-styled painting. Thereafter, a brief, general introduction to fractal dimension analysis and its application in research on art and design is presented, followed by a description of the specific conditions and settings in which this present study was conducted.

Finally, the results of the fractal dimension calculations are presented, followed by comparative mathematical analysis as well as interpretive discussions.

Before the analysis, some points must be clarified. First, the focus of this study is not the architectural works of Doshi (in this case, Sangath), nor the artistic representation of these works (i.e., Doshi's miniature-inspired painting of Sangath), but instead the *relationship*, in terms of visual complexity, between two different modes of visual representation of Doshi's works (Sangath). Consequently, the analysis conducted in this study was designed in specific conditions and settings (as explained more thoroughly later) that are different from the settings for the study concerned solely with either architecture or artwork. Second, the scope of this study is restricted only to the *formal* properties (i.e., the visual complexity) of Sangath, or more precisely, the modes of visual representation thereof. Without any intention to understate the cultural, historical, philosophical, or contextual significance of Doshi's works (architectural as well as artistic), this paper does not directly consider such aspects. Nevertheless, future studies combining formal and non-formal analysis of the works are possible and advisable.

Literature Review

1. Balkrishna Doshi and His Architecture

Born in 1927 in Pune, India, Balkrishna Vithaldas Doshi began his architectural education in Bombay, and in 1951 he went to study in London, during which time he was introduced to the modern architect Le Corbusier at the 8th CIAM (*Congrès Internationaux d'Architecture Moderne*—International Congress of Modern Architecture). In the end, Doshi worked for Le Corbusier in Paris from 1951 to 1954, and in 1955 he supervised several of Le Corbusier's projects in Ahmedabad, India. In 1962, Doshi got the chance to work with another great modern architect, Louis Kahn (together with Indian architect Anant Raje) on the project of the Indian Institute of Management (IIM), also in Ahmedabad.

His encounters with these two modern masters had a significant impact on Doshi's work (Doshi, 2012); however, Doshi eventually felt compelled to formulate his architecture as a response to both the past and the future of India, his homeland. Doshi's continuous search establishes him as one of the most respected contemporary architects in India; in 2018 he was awarded the Pritzker Prize for architecture. Doshi's architecture displays a clear influence of Modernism; yet, at the same time, his works reflect his deep understanding of the non-architectural aspects he is so fond of, which is the complexity of the "whole web of life" (Curtis, 1988, p. 24) in India. His architecture is architecture for the people (Kugler, Hoof, & Wolfschlag, 2019).

2. Indian-Mughal Miniature-Inspired Paintings of Dhosi

One of the aspects Doshi noted from his time with Le Corbusier is the latter's interest in Indian-Mughal miniature paintings. In his opinion (Doshi, 2012; Doshi, Chauhan, & Pandya, 2006), there are some indications, albeit not very clear, that Le Corbusier took inspiration from these miniatures for his architectural works in India. Still, in Doshi's opinion, it was the presence of *multiple vantage points* in these miniatures that interested Le Corbusier (and later Doshi himself) most: how, in one same image, the "front and back are both shown"; how the painter is capable of getting "another dimension within the same plane" (Doshi, 2012, pp. 13–14); something that might never happen in the classical perspective system. The perspective system, with its single vantage point, was developed in the Renaissance Era and is thus associated with European art (Berger, 1972); since then, it has been widely accepted as the standard and rule of realism. In this respect, since Indian-Mughal miniature paintings portray 3-dimensional space in a unique system differing from the classical perspective, this may be seen as a rebellion, an exception to the rules (of the classical perspective system); and indeed, this notion of *breaking the rigidity* is one of the miniatures'

characteristics that attract Doshi (Doshi, 2012).

However, it should be noted that multiple vantage points cannot be exclusively associated with Indian-Mughal miniature paintings specifically or even non-Western arts in general. Indeed, among numerous schools of thought emerging (and disappearing) throughout the history of contemporary Western art, there is at least one 'ism' to which the presence of multiple vantage points is often credited as one of its most prominent characteristics: Cubism (Grzymkowski, 2013). Cubism allows the painter to "combine various views of [an object] into a single image" (Saunders, 2014, p. 133), much like the Indian-Mughal miniature paintings. This might also be the other reason for Le Corbusier's interest in these miniatures; in 1918, three decades before his encounter with Doshi and the miniatures, together with Amédée Ozenfant, he developed a derivative of Cubism called purism (Sennott, 2004), from which the formal language of his modern architectural works took inspiration. Despite some fundamental differences between these two artistic 'isms' (Sennott, 2004; Kleiner, 2016), Le Corbusier undoubtedly was familiar enough with the features and characteristics of Cubism. Thus, in discovering the presence of multiple vantage points in Indian-Mughal miniature paintings, he might well be reminded that this feature is indeed far older than any contemporary 'ism' might proclaim.

Whatever his reason might be, Le Corbusier's interest, in turn, sparked Doshi's interest in Indian-Mughal miniature paintings, particularly since the former took such miniatures as an inspiration in designing Shodhan House (1956). Yet, it was not until around 1984 that Doshi first painted his first miniatures for an exhibition in Philadelphia, for which he felt the need to express his architectural works in a uniquely Indian way. He was indeed interested in the multiple vantage points offered by the miniatures, in that this characteristic enables a single image to become "a compressed expression of a complete story of life" (Doshi, Chauhan, & Pandya, 2006, pp. 20–21), bringing to mind a certain viewpoint on Indian-Mughal miniature paintings as "narrative structure" (Sheikh, 2008, p. 147). After these first experiments, Doshi continued making these miniature-inspired images, and his later, matured paintings display impressions such as "porosity", "layering", "permeability", "flux", and "growth" (Hoof, 2019, p. 9); in short, characteristics that represent India, which may be summarized in one notion: *complexity*. In the end, these paintings became one of his most renowned techniques for expressing the true intents of his continuous search; that architecture, particularly an architecture for India, should reflect as well as accommodate the whole nuances, various facets, and complexity of people's lives.

3. Sangath: The Architect's Studio

Among Doshi's architectural works, which he first depicted in the form of paintings inspired by Indian-Mughal miniatures, is Sangath, his architectural studio as well as the office of Vastu-Shilpa Foundation for Studies and Research in Environmental Design, completed in 1980 and located in Ahmedabad, a city in which historical Indian architecture, as well as the works of Le Corbusier and Louis Kahn, are located. Understandably, Doshi chose Sangath (which means "moving together through participation" in Gujarati) as one of the first objects for his paintings, given that this work is regarded by Doshi himself and the critics as one of the crucial turning points in his career (Curtis, 1988; Doshi, Chauhan, & Pandya, 2006; Ashraf, 2019; Melotto, 2014). In the context of this study, it is the formal experiment in Sangath that might be its most prominent and significant characteristic. Sangath demonstrates Doshi's skill in expressing into space and form notions such as dynamism, ambiguity, duality, interlocking of space, transition, and avoidance of directionality (Curtis, 1988; Ashraf, 2019; Melotto, 2014). In short, it demonstrates *complexity*, an idea so prevalent and prominent in Indian daily life, and which Doshi has always been (and still is) trying to capture in his works.

It is this very complexity that Doshi might also try to present in his miniature-styled painting of Sangath (1984). Surrounded by non-architectural components (entourages) mostly consisting of the natural landscape, the building is depicted in a larger context; instead of being a sacred, alienated object, the building participates in the life taking place around it (Figure 1a).

Yet the painting's complexity, to which this study is focused, lies not in the abundance of these entourage elements, but rather in the way multiple vantage points are combined in one frame, much like the Indian-Mughal miniature

paintings from which Doshi took inspiration. Although at first glance, the painting gives an impression of a 3-dimensional situation, it is indeed a remarkably clear combination of *three purely orthographic*, 2-dimensional vantage points: one top view depicting the roof plan (block plan) and two side or elevational views—front (South) and right (West) elevations (Figure 1b). In this way, Doshi's painting of Sangath is different from the other, more conventional 2-dimensional modes of visual representation of architecture depicting three-dimensional situations. The painting indicates neither a convergence of foreshortened lines (as found in perspective drawings) nor a change from perpendicular to the angled depiction of the planes (as found in axonometric drawings). In his later paintings, Doshi began to combine orthographic, perspective, and axonometric vantage points in a more complicated and ambiguous manner. While these later paintings may be analyzed in future works, this paper is indeed intended as an initial study, for which the clarity of this painting of Sangath is crucial.

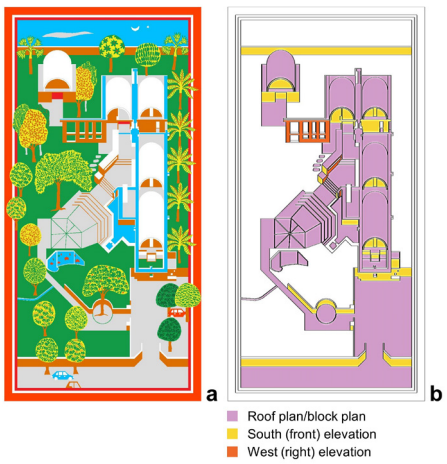
In conclusion, it is these qualities—its remarkable position in Doshi's career, its role as one of Doshi's first works depicted as miniature-styled paintings, and its relatively straightforward and clear manner in combining multiple vantage points—that make Sangath a particularly suitable object for this study, in particular the last characteristic. The logical consequence of this specific feature to how this study was designed is described later in the sub-section "The Two Modes of Visual Representation", after a brief introduction to fractal dimension analysis and its applications in investigating arts and designs.

Methodology

1. Fractal Dimension Analysis

Fractal dimension is an indicator of the *visual complexity* of 2-dimensional images and 3-dimensional objects. Directly proportional to the complexity of an image or an object, fractal dimension takes the form of a *fraction or non-integer value*. Thus, a value of, say, 1.25 indicates a 2-dimensional image with low visual complexity, whereas a value of 2.75 indicates a 3-dimensional object with high visual complexity. The method to calculate fractal dimension, which is known as the *box-counting method*, was first proposed by Mandelbrot

Figure 1. a) Redrawing of Doshi's painting of Sangath (1984), and b) a diagram showing three orthographic vantage points
Source: Author, modified from Kugler, Hoof, & Wolfschlag (2019)



(1982), but the first use of the method is commonly credited to Voss (1986). Afterward, studies utilizing fractal analysis have been conducted more frequently in various fields, including art and design.

Indeed, complexity can and should be considered an aesthetic factor in artwork; it has been suggested that the interplay between order and complexity takes crucial role in aesthetic appreciation (Van Geert and Wagemans, 2020). Yet, as Forsythe et al. (2011) mentioned, there are many more factors that must be considered in determining the quality of an artwork than mere visual complexity (which fractal dimension indicates). Nevertheless, this doesn't prevent the prolific emergence of fractal-related studies of art. Taylor, Micolich, and Jonas (1999) analyzed the drip-paintings of Jackson Pollock, and fractal dimension was used again by Alvarez-Ramirez, Ibarra-Valdez, and Rodriguez (2016) to indicate the major change(s) in Pollock's artistic evolution, and later to compare Pollock with Jean-Paul Riopelle, proving that the latter's paintings possess higher fractal complexity than Pollock's (Alvarez-Ramirez et al., 2019). Moctezuma and Gonzáles-Gutiérrez (2020) conducted fractal analysis on sand drawings. Burcoff and Shamir (2017) studied Picasso's works. Bountis, Fokas, and Psarakais (2017) focused on Mondrian's tree painting. Henemann, Brachmann, and Redies (2017) studied several statistical properties, including fractal dimension, of the works from the Prinzhorn Collection of artists with schizophrenia. In a

rather similar objective, Forsythe et al. (2017) demonstrated the correlation between cognitive deterioration and the changes in fractal dimensions of the paintings made by several artists; and in a rather similar approach, Redies and Brachmann (2017) analysed statistical properties, including fractal dimension, of traditional art, *Bad Art*, and abstract art. Taylor et al. (2017) conducted fractal analysis on Rorschach inkblots, suggesting that images perceived by the respondents are influenced by fractal properties. Mureika and Taylor (2013) used multifractal analysis to compare the Abstract Expressionists and Les Automatistes. Balankin and Márquez (2003) analyzed several other artists' works.

The notion of the relationship between paintings and architectural works in terms of fractal dimension has already been voiced by Taylor (2007), wherein he discussed the paintings of Pollock and the architecture of Frank O. Gehry. In his seminal book, Bovill (1996) comparatively analyzed one of Le Corbusier's purist paintings, *Nature Morte à la Pile D'assiettes*, and the elevation drawing of one of his most famous architectural works, Villa Savoye. This is a particularly appropriate comparison since the villa "suggests a purist painting extruded into the third dimension", albeit "loosely" (Treib, 1994, p. 47). However, the painting and the drawing are, after all, two different depictions of two different *objects*.

Inspired by these studies, this study proposes a comparative fractal dimension analysis of the artwork and the architecture of Balkrishna Doshi. This present paper focuses on a *single object*—Sangath, which is Doshi's studio and the office of Vastu-Shilpa Foundation—depicted in the *two modes of visual representation*, as described in the following sub-section.

2. The Two Modes of Visual Representation

This study is based on the notion that Doshi's artistic style in depicting his works, wherein multiple vantage points are combined within a single frame, might be able to portray an idea of complexity better than the more conventional modes of architectural representation. In a simplified manner, are these paintings indeed more complex visually than the conventional modes? To answer this question, it is important to mathematically calculate and compare the visual complexity of these two modes of visual representation.

The first mode of visual representation selected to be analyzed in this research is Doshi's painting of Sangath, whereas the *second mode* is represented by the *orthographic drawings* of the same building, for two reasons. First, since Doshi's painting is a 2-dimensional form of representation, it is necessary to take a 2-dimensional representation of the architectural work as well for the comparison, and orthographic drawings are the logical and objective mode for 2-dimensional fractal dimension analysis of architectural objects (Ostwald & Vaughan, 2016). Second, as described previously, Doshi's painting of Sangath combines, in a remarkably clear manner, three vantage points as found in the 2-dimensional orthographic drawings: the roof plan (block plan), the front (south) elevation, and the right (west) elevation. Therefore, for a proportionate comparison, it is logical to compare the painting with these three orthographic drawings.

In conclusion, the images utilized in this research are (1) Doshi's painting of Sangath, (2) the roof plan/block plan, (3) the front/south elevation, and (4) the right/west elevation. Before the calculation, these images must undergo the *preparation procedure*, as described in the next sub-section.

3. Image Preparation

To ensure the validity of the comparative fractal analysis, the images must be depicted in an equally comparable manner. In this respect, the images analyzed in this study must be prepared through a set of procedures.

First, all the images must be redrawn into a single type of drawing, namely *line drawing*, which is a common mode to depict orthographic drawings of architectural objects. Although Doshi's painting of Sangath is not a line drawing—since he used blocks of flat color—the painting can be redrawn into a line drawing in a relatively straightforward manner. Thus, the painting was transformed into a line drawing (Figure 2a) based on the image presented in the book *Balkrishna Doshi: Architecture for the People* (Kugler, Hoof, & Wolfschlag, 2019), and the orthographic drawings were redrawn based on Doshi's submission to the Aga Khan Award for Architecture (Doshi, 1983).

Second, since the purpose of this study is to evaluate whether Doshi's choice to portray his

architecture in his formal signature style (i.e. the manner wherein several orthographic vantage points are combined within a single image) may increase the visual complexity significantly compared to the more conventional modes of representation in architecture, it is important to calculate only the architectural components depicted in the line drawing version of the painting, removing all the non-architectural components (Figure 2b). However, to check whether architectural or non-architectural components contribute more to the complexity of the painting, the line drawing of the painting depicting both the architectural and non-architectural or entourage components (Figure 2a) was also calculated.

Table 1. Methodological variables and settings

Stage	Variable	Setting	Notes
Image preparation	White space	50/50	The dimension of the field was determined by enlarging the rectangular outline of the image by the scale of 1.4142 (~√2); this results in the ratio of 1:1 or 50/50 between the area of the image and the white space around the image
	Image position	Centre-centre	The image was located at the centre of the field before the analysis
Data processing	Scaling coefficient (SC)	1.4142:1	This is the ratio by which successive grids are reduced in size
	Grid disposition (GD)	Centre-growth	Successive grids for comparison were all generated from the centre of the image
	Grid comparison	10	The number of grids/iterations
	Starting grid size	0.25 l	The first grid was generated by dividing the shortest dimension of the field by four

Source: Author, compiled from Foroutan-Pour, Dutilleul, and Smith (1999), Vaughan and Ostwald (2009), Ostwald and Vaughan (2013)

Third, for the comparison to be proportionate, the architectural components depicted in the orthographic drawings must correspond to those depicted in Doshi's painting. Thus, the roof plan, the south elevation, and the west elevation of Sangath were redrawn by referring to the architectural components depicted in Doshi's painting (Figure 3a, b, and c).

Figure 2. Line drawings of the painting of Sangath. a) The architectural and the entourage components; and b) only the architectural components
Source: Author

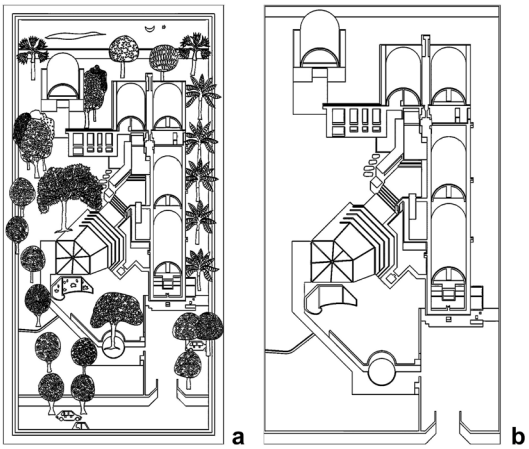
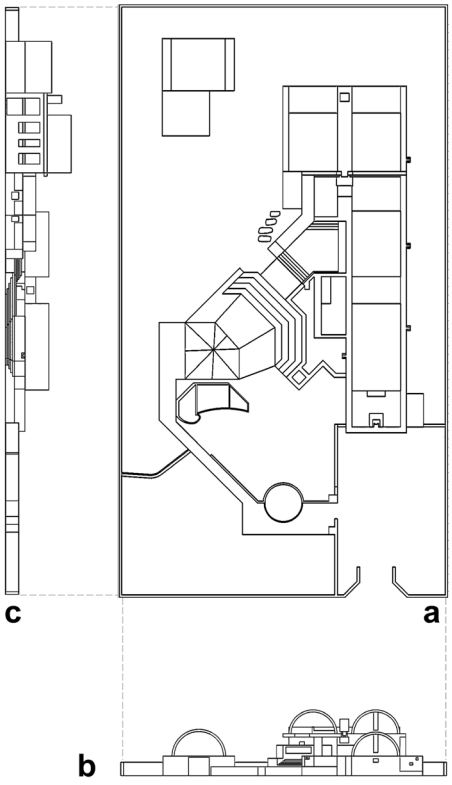


Figure 3. Orthographic drawings of Sangath. a) The roof plan; b) the south (front) elevation; and c) the west (right) elevation
Source: Author



Fourth, both the two modes of visual representation in this research must be depicted with an equal level of detail. Again, in this case, the standard is the painting. Therefore, for

example, while the original elevation drawings might depict the mullions of the windows and doors, since the painting depicts them as mere single-lined rectangles, the windows and doors must be depicted as such in the final orthographic drawings.

Finally, all these equally detailed drawings must be prepared according to certain methodological variables and settings as described by Foroutan-Pour, Dutilleul, and Smith (1999) and perfected by recent studies (Vaughan & Ostwald, 2009; Ostwald & Vaughan, 2013). These variables and settings are summarized in Table 1.

4. Data Processing

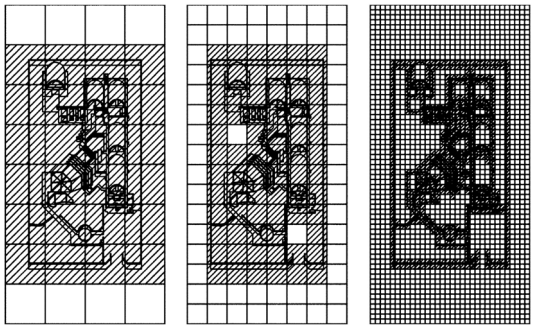
The method for calculating fractal dimension used in this research, namely the *box-counting method*, states that a set of grids containing boxes of varying numbers and sizes must be superimposed over the preprocessed images (Figure 4). Since the sizes of the boxes are diminished according to a certain *scaling coefficient* (SC)—which, in this case, is 1.4142 or ~√2—this process results in different *numbers of boxes containing parts of the images* (N#, in which # = the #th iteration) for each grid. In this study, this process was iterated 10 times, following the suggestion from Ostwald and Vaughan (2016) about the minimum and ideal number of iterations for an accurate result. Then, the approximate fractal dimension (D#) is calculated using Equation 1:

$$D\# = \frac{[(\log(N\# + 1) - \log(N\#)]}{\log(SC)} \quad \text{..... (1)}$$

D# = approximate fractal dimension
N# = numbers of boxes containing parts of the images
SC = Scaling Coefficient

The final fractal dimension (D) is calculated as the average value of a set of D# values. The methodological variables and settings for the data processing are resumed in the previous Table 1.

Figure 4. Illustration of the box-counting process of the line drawing of Doshi's painting of Sangath depicting the architectural components only
Source: Author



Results and Discussions

The calculations produced 2 (two) fractal dimension values (D) for the line drawings of the miniature-styled painting of Sangath: the version depicting the architectural components only (D_A) and the version containing the architectural components together with the non-architectural or entourage components (D_{A+E}). For the orthographic drawings, 3 (three) fractal dimension values were produced: the roof plan (D_{RP}), the south (front) elevation (D_{SE}), and the west (right) elevation (D_{WE}). Finally, the differences (Diff) between the fractal dimensions of the line drawings of the painting and the orthographic drawings were also calculated. These complete mathematical results are summarized in Table 2.

The results show a relatively low visual complexity for the orthographic drawings with an average fractal dimension value (D_{Av}) of 1.312; the fractal dimensions of the roof plan (D_{RP}), the south elevation (DSE), and the west elevation (D_{WE}) are 1.380, 1.313, and 1.244, respectively. It should be remembered that what these values reflect is the complexity of the visual representation of the building, and not that of the real architectural work. Meanwhile, the fractal dimension of the line drawing of the painting depicting only the architectural components (D_A) is 1.495, indicating a somewhat moderate level of visual complexity, whereas the fractal dimension of the image depicting both the architectural and entourage components (D_{A+E}) is 1.714, indicating a remarkably high level of visual complexity. However, it should be noted that the difference

between these two values ($Diff_{A/A+E}$), which implicitly indicate the extent to which the *non-*architectural or entourage components *alone* (E) contribute to the "total" visual complexity (architecture + entourage), is 0.219 or 30.7%. This means that the architectural components *alone* contribute a larger part (59.3%) to the "total" visual complexity of the painting of Sangath; thus, the idea of comparing the orthographic drawings with the architectural components *alone* of the painting is valid.

The most important results are the differences, particularly between the fractal dimensions of the orthographic drawings and the fractal dimension of the painting with the architectural components depicted alone. These differences range from 11.5% ($Diff_{RP/A}$) to 25.1% ($Diff_{WE/A}$), with an average value ($Diff_{Av/A}$) of 18.3%. As a comparison, the differences between the values of the orthographic drawings and the image depicting both the architectural and entourage components range from 33.4% ($Diff_{RP/A+E}$) to 47.0% ($Diff_{WE/A+E}$), with an average value ($Diff_{Av/A+E}$) of 40.2%.

The aim of this study is to evaluate whether Doshi's unique style of depicting his architectural works (in this case, Sangath) does indeed result in significantly higher visual complexity compared to the more conventional mode of architectural representation (in this case, the orthographic drawings). Thus, the crucial question here is: what is the minimum difference between the fractal dimensions of the images (or objects) to be considered significantly different in terms of visual complexity? Regarding this question, Vaughan and Ostwald (2009) stated that the value is 4%. This is the minimum difference between the fractal dimensions of objects whose visual differences can be perceived readily by the human eye.

In this sense, these results confirm, in a quantitative and mathematically measurable manner, the notion that formed the basis of this study: that Doshi's miniature-styled painting of Sangath does indeed possess a significantly higher visual complexity than that of the orthographic drawings of the same building. Even when the painting was calculated in the form of a line-drawing depicting only the

Table 2. Complete mathematical results

Difference (Diff) between Fractal Dimension Values (D)			Fractal Dimensions (D) of the Orthographic Drawings			
			Roof Plan (RP)	South Elevation (SE)	West Elevation (WE)	Average (Av)
			D_{RP} = 1.380	D_{SE} = 1.313	D_{WE} = 1.244	D_{Av} = 1.312
Fractal Dimensions (D) of the Painting	Architectural Components (A)	D_A = 1.495 (59.3%)	$Diff_{RP/A}$ = 11.5%	$Diff_{SE/A}$ = 18.2%	$Diff_{WE/A}$ = 25.1%	$Diff_{Av/A}$ = 18.3%
	Architecture + Entourages (A+E)	D_{A+E} = 1.714 (100%)	$Diff_{RP/A+E}$ = 33.4%	$Diff_{SE/A+E}$ = 40.1%	$Diff_{WE/A+E}$ = 47.0%	$Diff_{Av/A+E}$ = 40.2%
	Entourages (E)	$Diff_{A/A+E}$ = 0.219 (30.7%)	-	-	-	-

Source: Author

architectural components, its fractal dimension is still remarkably higher than that of the average D-value of the conventional drawings by a difference of 18.3%, far higher than the minimum value (4%) proposed by Ostwald and Vaughan. Even the lowest D-difference between the painting and the most complex drawing—the roof plan—($Diff_{RP/A}$) is still significantly higher than 4% (11.5%), indicating a higher visual complexity.

Finally, it should be noted that visual complexity is only one aspect of the formal properties of Doshi's paintings. There are still many more possible readings from the viewpoint of the non-formal aspects of these paintings, which are beyond the scope of this study. It is possible that future works, by including more works of Doshi's as well as combining formal and non-formal analysis, may provide a better understanding of the relationship between Doshi's architectural and artistic works.

Conclusion

By calculating and comparatively analyzing the fractal dimension of Doshi's painting of Sangath as well as the orthographic drawings of the same building, it is possible to demonstrate quantitatively and measurably that this painting of Doshi's, by combining multiple vantage points in one frame, is indeed visually more complex than the conventional orthographic drawings. This can be interpreted as Doshi's strategy to further express his idea of complexity in architecture through paintings, at least in a formal-visual manner.

Whether the results from this initial study may indicate a general characteristic of Doshi's *oeuvre* is not yet known. It requires many more calculations over more complete sets of Doshi's architectural and artistic works. Even then, a more comprehensive analysis encompassing both formal and non-formal aspects is advisable for a deeper understanding of the presence and manifestation of complexity in Doshi's works.

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