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Revisiting Vitruvius' Town Planning Method in Architectural Education

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ABSTRACT

This paper discusses the method of town planning described in Vitruvius' *Ten Books on Architecture* and explores the possibility of its application in the process of design learning in architectural education. In particular, it addresses the prescriptive nature of the texts that outlined the method of town planning as an example of contextual strategies to highlight the key aspects of the design methodology to be followed in a structured manner. To explore the extent to which this method is applicable in a real design process, Vitruvius' texts on town planning became the basis for method exploration in a class of undergraduate architectural education. The exercise of developing a set of town plans following the principles highlighted in the texts demonstrates the robustness of the methods outlined by Vitruvius. Revisiting Vitruvius' methods through this exercise becomes a way to understand and rethink the position of Vitruvius' texts within current architectural practice and education.

Keywords: Vitruvius, town planning method, design education

BACKGROUND

Revisiting Vitruvius Beyond the Triad

Vitruvius' *Ten Books on Architecture*, or originally entitled *De Architectura*, is perhaps one of the most influential texts on architecture that has been referred to by both academics and professionals until now. This classical 'must-know' text lays out the basic requirements that should be followed in order to create good architecture, which is commonly known as Vitruvius Triad: *venustas, firmitas, utilitas.* Various other terms parallel to these were also found in several translated versions of the text. For example, Vitruvius (1960) mentioned the terms *beauty, durability,* and *convenience,* while the terms *commodity, firmness,* and *delight* were found in Henry Wotten's translation in 1624 (Mallgrave, 2006).

Vitruvius was the first—as he himself proudly maintained—to cover the entire field of architecture in a systematic way (Kruft, 1994). In fact, his writing is the oldest form of the written text on architecture that has survived and is accessible for today's generation. The text has been translated into many languages during different periods (Vitruvius, 1860). Careful examination of the text reveals that it "embraces many more concerns than what today is considered to fall within the realm of architecture" (Mallgrave, 2006, p. 4). The majority of the discussion on Vitruvius in academic and professional practice is dominated by the Vitruvius Triad, although more debates also exist regarding the relevance and the broader implications of Vitruvius' texts on the development of design and theories.

Because the writing of Vitruvius has been influential for many centuries of practice and education, it is necessary to revisit it. On the one hand, the text has provided a clear prescription of design methods; on the other hand, the influence of Vitruvius has also raised questions and criticism. For example, Till argued that "Just because he was first does not necessarily make him right, but his shadow over architecture remains long" (Till, 2009, p. 27). He further described that our acceptance of the Vitruvius Triad is like "unthinking acceptance of a baton being passed from century to century" (Till, 2009, p. 27). These comments reflect a demand to revisit the ideas outlined by Vitruvius and to put the ideas appropriately into the context of current architectural practice and education.

A problem with the interpretation of Vitruvius is argued by Heath who argued that "Vitruvius is today misunderstood and underestimated" (Heath, 1989, p. 246), suggesting the need to discuss further Vitruvius' *Ten Books* in its entirety and not to be confined with only the well-known Vitruvius Triad. Even the triad itself may be subject to further debate. Although the three criteria are by definition clear, the practical implementation may open countless possibilities of how to achieve them. One may debate how architects may in practice develop methods that would fulfil the three criteria of *venustas, firmitas* and *utilitas*, and how architects and critics may develop standards of judgment on the extent to which these three criteria have been met. Salama (2007) argued that the relationship and the interdependencies among the three criteria have become a challenge within the discourse of architectural theories and have so far never been addressed entirely.

Till further argued on the three qualities of architecture according to Vitruvius, "but these qualities are so self-evident that they should be background beginnings rather than foreground ends that the Vitruvian dogma suggests" (Till, 2009, p. 27). Thus, it is contested that the Vitruvian triad needs not to be swallowed as a blunt and concise concept of beauty, durability, and convenience. What lies ahead and beyond those concepts may well be worth further dialog, especially when we expect to position it within the context of current architectural practice and education.

Salama supposed that the triad outlined by Vitruvius needs to be followed by more ideas. "Undoubtedly, Vitruvius gave us the ABC of architecture, but someone should have continued the alphabet of architectural theories" (Salama, 2007, p. 122). Salama even further proposed the idea of Nikos Salingaros as a *New Vitruvius*, although Salingaros (2007) himself later denied this and believed that Christopher Alexander was more suitable for that title. Salama explained that Salingaros deserved to be called a new Vitruvius because he offered "a new alphabet that corresponds to the demands placed upon the

profession by contemporary societies" (Salama, 2007, p. 122). This argument clearly indicates the need for further studies to continue what Vitruvius began centuries ago.

Some studies examined further Vitruvius' texts to explore the possibility for rethinking the prescribed methods and to consider their relevance to the modern and current design practice. For example, Manenti (2019) examines the geometrical system prescribed in Vitruvius' texts and the operability of the system in design practice. He argued that Vitruvius' texts demonstrate an architectural system that is coherent and flexible, allowing for freedom for further development. Fuchs (2020) compared the geometrical principles in various temples and the prescription in Vitruvius' book. He found that the guidelines prescribed by Vitruvius only suggest one possible system of geometrical composition, which may be different from the existing practice of design at that period. Kashima and Kishigawa (2012) more specifically examined Vitruvius' town planning method and compared it with other Renaissance town planning methodology. They found the continuity of some key principles to the modern ideas of town planning. There is also an attempt to reinvent the ideas of Vitruvius through digital reconstruction of the works, as a way to explore their feasibility and possible performance (Brillarelli et al., 2020).

Vitruvius provides a model of architectural thinking which opens up a further challenge to find its relevance for today's practice and education (Newman & Vassigh, 2016). This paper attempts to position the texts in Vitruvius' *Ten Books* as a contribution to the methodology of architectural design. In particular, we intend to establish a possibility of expanding the use of the texts within the design learning process in architectural education, through an exercise of applying the town planning methodology. The objective of this exercise is to explore the possibility of the texts in providing guidance on design methods and to what extent the texts allow the students to generate various possibilities. The following sections will present an overview of the texts on design methodology in Vitruvius' Ten Books, particularly the sections related to town planning, followed by a description of our methods of study in applying the methods in a design exercise. The findings from the exercise will suggest some ideas regarding the position of Vitruvius' methodology within the development of design methods, especially in architectural education.

Vitruvius' Texts as Prescription of Design Methods

The main contents of Vitruvius' *Ten Books* are more than just the Vitruvian Triad as commonly known by many architects and architecture students. In fact, the text contains significant materials on design methodology. *Ten Books* is a text of prescriptive nature. Having inspected the book in its entirety, one may find that Vitruvius provides very detailed accounts on how to plan towns, design buildings, and create pieces of machinery. The contents of the book, from Book I to Book X, include the principles that are to be followed in order to create good architecture.

Vitruvius began Book I with a discussion on the nature of architecture as multidisciplinary—or the so-called 'liberal arts' and argues the need to understand many branches of knowledge in order to be a good architect. Book I also contains a thorough prescription on building a town, which would go on to become the main theme of discussion in this paper. Book II outlines the basic principles of construction and materials, which Vitruvius believed are necessary to understand before one could begin to work on any building type. Book III and IV discuss temples, including the principles of symmetry and proportion, the construction consideration, and the details of various elements of the temples. The rest of the texts deal with various types of public buildings (Book V), private buildings (Book VI), principles of building finishes (Book VII), water infrastructure (Book VIII), sundials and clocks (Book IX), and machinery (Book X).

The prescription in the *Ten Books* includes practical guides on determining building shapes, construction methods, compositional principles, materials, environmental considerations, and many more. However, Heath believed that the importance of Vitruvius' writings does not lie merely on the practical information on materials and construction, nor the principle of proportion. His writing should be considered "in the context of a method, and it was his method which was primarily responsible for his continuing success"

(Heath, 1989, p. 246). The position of methods as a core principle in the act of architecture was also later emphasized by Durand (2000), who expresses his thoughts in his writing *Précis of the Lectures on Architecture*, taking architecture without reference to building, but considering it as an inaugural act of designing (Picon, 2000).

The methods outlined by Vitruvius are grounded on logical reasoning. Vitruvius defined architecture as science (*architectura est scientia*), which could be interpreted as "intellectual, rationally conceived activities" (Evers, 2003). This may also explain architecture as a scientific discipline that is based on logic and not merely based on intuition or instinct. The logic of architecture was demonstrated by Vitruvius in his description of methods, in which the prescriptions he provided were further explained with reasons and background. Understanding the reasons and background behind an idea written by Vitruvius becomes important in order to create purposeful architecture. In some of his prescriptions, the logical connection between Vitruvius' Triad of *venustas, firmitas*, and *utilitas* becomes clear. For example, the explanation of temples in Book III implies a relationship among how certain types of temples should follow various compositional theories, how they are functional, and how they should be constructed. It seems that the application of each of the triad is not merely independent but emerged as a demand put by one another.

Being a logical method with a detailed explanation of the background reasoning, Vitruvius' prescription in *Ten Books* could be followed to design a building. Heath (1989) took the case of a private dwelling and concluded that if one was given a client and a site, he or she would be able to follow the methods outlined by Vitruvius and produce a design of a Roman house "with comparatively little trial and error" (Heath, 1989, p. 248). Nevertheless, a question also emerged as to what extent the methods outlined by Vitruvius are rigid as a guideline for his followers. It is also unclear to what extent the results of the architecture created following Vitruvius' method may be satisfied in various contexts with different restrictions. However, Heath (1989) further argued that the method outlined by Vitruvius is highly adaptable and would allow one to adapt the principles of Vitruvius to other conditions. Vitruvius (1999) also emphasized that Vitruvius' prescription is not rigid and that Vitruvius' *Ten Books* suggest the need for adjustment along with the design process. They reason that Vitruvius offers a set of recommendations while at the same time also providing some principles for development (Manenti, 2019).

The above arguments reflect the two different sides of Vitruvius' methods. On the one hand, the methods offer clear instructions that could be followed as they are and become a method of designing. What Vitruvius has written suggests a clear, detailed design method, which is written in a well-organized and coherent manner (Manenti, 2019). The objective of Vitruvius in detailing all these methods was already mentioned in the preface of Book I, where he wrote to Imperator Caesar, "I have drawn up definite rules to enable you, by observing them, to have personal knowledge of the quality both of the existing buildings and of those which are yet to be constructed" (Vitruvius, 1960, p. 4). The methods he exposed in this book reflect on the principles used for designing and constructing the existing building and to prescribe guidelines to be followed for the new buildings.

On the other hand, the arguments from previous studies indicate that the method is also highly adaptable, allowing possibilities to vary from the prescribed criteria. Nevertheless, the extent to which the methods offer a clear prescription for the design process is open to debate. There might be a question of whether anyone following the methods would be able to produce the design and buildings of similar qualities. These become important issues especially within the context of architectural practice and education with the need to teach the balance between standard requirements and allowances for adjustment, innovation, and creativity. To examine further the role of Vitruvius' prescriptive texts in guiding the act of designing, in this study, we conducted an exercise by following the Vitruvius' texts in a structured manner, in particular the texts on town planning methods as explained below.

Vitruvius' Texts on Town Planning Methods

This study focuses on examining the texts in Vitruvius' *Ten Books* regarding the methods of designing a fortified town, as found in Chapter IV to VII Book I. The explanation began with the requirements regarding the site (Chapter IV), followed by the prescription for the city walls (Chapter V), the direction of the streets (Chapter VI), and the sites for public buildings (Chapter VII). These explanations also serve as the introduction to the rest of the books, which explain in detail about design requirements for different types of public and private buildings, infrastructure systems, and defensive machinery needed for such fortified towns. The following section contains some excerpts from the chapters on town planning, which will be further used in this study as the basis of students' design exercise.

The site

The requirements of laying out a plan of a city begin in Chapter IV titled "The site of a city," which places emphasis on the need to consider health aspects in choosing the location where to build a town. This concerns the position of the chosen site in relation to its geographical position and climate conditions. Certain conditions of the site are unfavorable, such as a site with marshes or with exposure to a certain direction.

> For fortified towns the following general principles are to be observed. First comes the choice of a very healthy site. Such a site will be high, neither misty nor frosty, and in a climate neither hot nor cold, but temperate; further, without marshes in the neighbourhood. … Again, if the town is on the coast with a southern and northern exposure, it will not be healthy… (Vitruvius, 1960, pp. 17–18).

The capabilities in choosing the appropriate site that is healthy have also been mentioned by Vitruvius in his earlier chapter, where he suggests architects have knowledge of medicine in order to take responsibility in relation to climate, air, and healthiness of the site. This becomes important to ensure the healthiness of the dwellings within the site. In Chapter IV, Vitruvius further discussed how the environmental features of the site such as wind, heat, and moisture may have effects on the human body and dwellings on the site.

Vitruvius also explained a method of choosing a site by relying on cattle to check the appropriateness of the site as a place for living.

> Our ancestors, when about to build a town or an army post, sacrificed some of the cattle that were wont to feed in the site proposed and examined their livers. …They never began to build defensive works in a place until after they had made many such trials and satisfied themselves that good water and food had made the liver sound and firm. … From food and water, then, we may learn whether sites are naturally unhealthy or healthy. (Vitruvius, 1960, p. 20).

Some exceptions also appear in his prescription for healthy sites. While earlier he mentioned that marshes are unfavorable, at the end of the chapter he explained the possibilities, with evidence in the existing towns, that sites in marshes can be marvellously healthy.

The city walls

The requirements for a good site location are then followed by the guidelines in building the city walls in Chapter V, starting with laying the foundation for the towers and the walls. Vitruvius provided the guidelines for the shape, position, and size of the towers and the walls so that they comply with the requirements for defensive purposes of the city. The physical form of the towers and the walls should be designed in such a way that offers benefits to the cities against enemies approaching the town. These include exposing the enemy to the attack from within the city, allowing a view from the city toward the approaching enemy, and at the same time also allowing easy movement of the army defending the city while walking along the walls.

> The towers must be projected beyond the line of wall, so that an enemy wishing to approach the wall to carry it by assault may be exposed to the fire of missiles on

> his open flank from the towers on his left and right. Special pains should be taken that there be no easy avenue by which to storm the wall. The roads should be encompassed at a steep point, and planned so as to approach the gates, not in a straight line, but from the right to the left; for as a result of this, the right hand side of the assailants, unprotected by their shields, will be next the wall. The town must be laid out not as an exact square nor with salient angles, but in circular form, to give a view of the enemy from many points. The thickness of the wall should, in my opinion, be such that armed men meeting on top of it may pass one another without interference (Vitruvius, 1960, p. 22).

Vitruvius explained further that the positioning of the towers took into account the distance that can be covered by bowshot so that when the enemy attacked any of the towers, they could be repulsed by others from another tower. The suggested form of the tower is either round or polygonal, which was based on the consideration of the durability of the towers over the duration of battles. It was believed that "Square towers are sooner shattered by military engines, for the battering rams pound their angles to pieces; but in the case of round towers they can do no harm" (Vitruvius, 1960, p. 23).

The streets

The arrangement of streets and buildings within the city walls is then described in Chapter VI. The chapter is titled "The direction of the streets; with remarks on the winds." Vitruvius went on to explain the different types of wind and their effects on health. Then the positioning of houses, streets, and alleys was based on the need to keep out an unhealthy wind. This can be achieved practically by following the wind diagram which he also provided in the book as a basis for the arrangement of the houses and streets within the city walls.

> The town being fortified, the next step is the apportionment of house lots within the wall and the laying out of streets and alley with regards to climatic condition. … let the directions of your streets and alleys be laid down on the lines of division between the quarters of two winds. … by turning the directions of the rows of the houses and the streets away from their full force, we may avoid unhealthy blasts (Vitruvius, 1960, pp. 24–29).

The diagram of wind direction accompanying the text indicates a careful consideration of the geographical and meteorological aspects of the site. Vitruvius also described technical methods in determining the direction of the winds.

The public buildings

Chapter VII described the methods for the arrangement of public buildings in the city. Vitruvius suggests that the choice of the site location for each type of public building is based on consideration of convenience and utility. In addition, the sites for the temples are decided in relation to the characteristics and responsibility of the gods to whom the temples are dedicated. The geographical condition of the site also becomes another aspect to consider in determining the positioning of public buildings.

> If the city is on the sea, we should choose ground close to the harbour as the place where the forum is to be built; but if inland, in the middle of the town. For the temples, the sites for those of the gods under whose particular protection the state is thought to rest and for Jupiter, Juno and Minerva, should be on the very highest point commanding a view of the greater part of the city. Mercury should be in the forum, or like Isis and Serapis, in the emporium; Apollo and Father Bacchus near the theatre; Hercules at the circus in communities which have no gymnasia nor amphitheatres; Mars outside the city but at the training ground; and so Venus, but at the harbour (Vitruvius, 1960, pp. 31–32).

The chapter, as well as Book I of the *Ten Books* closes with a description of the site positioning of public buildings. Vitruvius concluded Book I by

mentioning that details of the materials to be used in the building would be explained in Book II, while the building proportion and arrangement would be explained in Book III. In this study, only the texts regarding the city planning will be used as the basis for design exercise, which will be explained in the following section.

RESEARCH METHODOLOGY

In order to explore the design prescription provided by Vitruvius and its impact on the actual process of design, we conducted a short design exercise as a part of a theory class at the Universitas Indonesia. We assigned a group of architecture students to read an excerpt from Vitruvius' *Ten Books*, in particular the texts from Book I which outline the methods of designing a city as quoted in the above section. After reading and discussing the excerpt in groups of three to four, the students worked on a design proposal of a city by strictly following the principles they understood in the excerpt. However, they also had the freedom to interpret such principles into various forms and arrangements as long as they complied with the written requirements. The objective of the exercise was to enable students to explore the major principles that they found and then to use them to determine the physical design of the cities.

The design exercise was a relatively short one, lasting for about two hours. At the end of the session, students produced the output of drawings and diagrams on up to two A1-sized pages. They could also add some annotations and text to give further explanations of their understanding and ideas. The analysis of the students' outputs from this exercise aimed to reveal the inside process of the students' thinking, especially to see the interplay between rationality and creativity (Harahap et al., 2019) in the interpretation of the prescribed texts and its application into design. The students' drawings and diagrams were analyzed to identify issues concerning the process of transforming principles into the design.

We identified the elements illustrated in the students' drawings and related them with the texts from Vitruvius as the basis of their work. In particular, we analyzed: a) whether the principles written in the texts are possible to be followed and then applied into the design; b) to what extent the principles imply the relationship between complex aspects of architecture as design considerations; c) to what extent the principles may generate diverse interpretation– whether there are some principles that would likely generate similar physical forms and whether there are some principles that would open possibilities for varying physical forms. Some examples of the drawings and diagrams from the exercise, and the main findings from the analysis, will be presented in the following section.

FINDINGS

Reinterpretation of Vitruvius' Design Principles

In responding to this design exercise, the students produced various plan and section drawings illustrating their ideas of a city based on Vitruvius principles, as illustrated in Figure 1 to Figure 4. The analysis of these drawings demonstrates three important features that the students interpreted from the texts and applied in their design ideas: a) the arrangement of the city that responds to the site context; b) the design of the city wall and towers to comply with the requirement to defend the city from the enemies; c) the arrangement of houses and the arrangement of public buildings.

Response to site context

The first finding from the drawings is the positioning of the city in relation to the natural condition of the site. The drawings illustrate how the city is located in relation to the sea/harbour and surrounding landscape features (such as forest and hill), as well as its position in the high land area. Such positioning is generally shown through the longitudinal section of the site, with remarks on the location of the sea, forest, and higher contours. Figure 1 (left) illustrates the position of the city in a higher level, away from the sea on one side and protected by the hill on another side. This example suggests compliance

with the principles outlined by Vitruvius in considering the healthiness of the site, which should be high and not located on the coast with either northern or southern exposure.

Figure 2 (right) illustrates the position of the city within the site contour drawing in which the shape of the city wall follows the shape of the site contour. In developing the arrangement of the town, the students were not required to work with a particular site context. The drawings indicate their interpretation on how the city arrangement should comply with the principles outlined in the texts, without referring to a specific context. In particular, the example in Figure 2 (right) demonstrates the attempt to adapt the city form to a specific site condition.

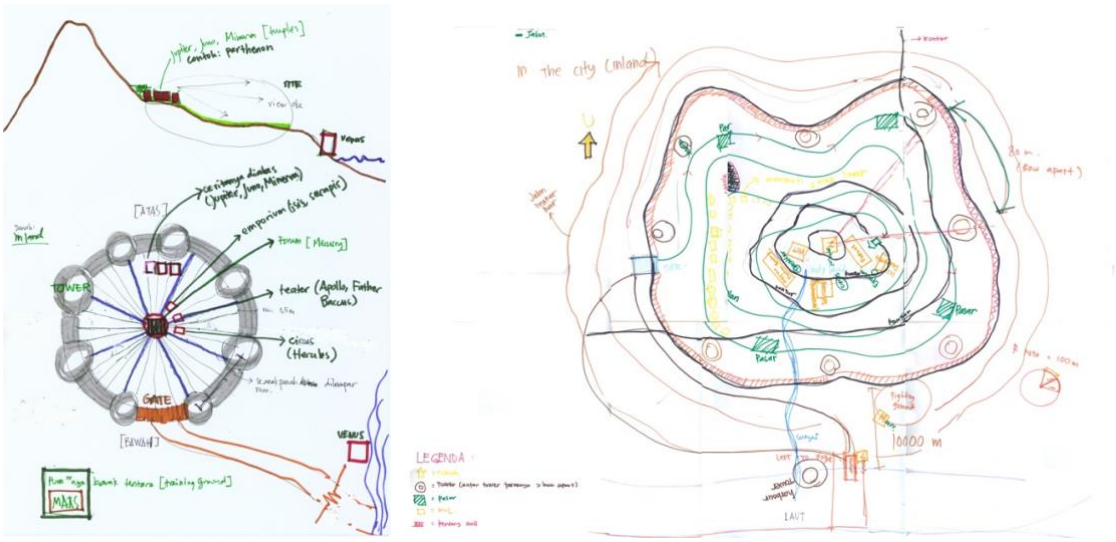
Design of wall and towers for defensive purposes

The second prominent feature found in the drawings produced by the students is the design of the city walls and the towers that comply with the requirements to defend the city from the enemies' attackers. The shapes of the wall refer to requirements of the city form to enable more views towards the enemy and the requirements of the shape of the tower, which should be either circular or polygonal to enable it to withstand the enemy's attack longer than square forms. Figure 2 (left) illustrates the polygonal shape of the city wall with the circular towers along the wall, while Figure 2 (right) illustrates the circular shape of the city wall with the polygonal towers projecting to the outside of the wall. These shapes are found in almost all drawings, and one plan proposes a rectangular form although it still maintains the circular angles in all its corners.

Figure 2 (left) also illustrates in more detail some of the requirements for the tower as the main element in defending the city from enemies. The depth of the wall should allow easy movement of the army, and the distance between towers should allow the enemies in between to be attacked from either tower. The requirements on the entry paths are also reflected in some drawings in consideration to the defensive strategies against the enemy. The positioning of the entry path became a particularly interesting topic of discussion during the exercise, especially in relation to the consideration of exposing the enemies' bodies with less protection. This has created an entry path that is not perpendicular to the city entrance, but winding from the side, as illustrated in both drawings in Figure 2.

Figure 1

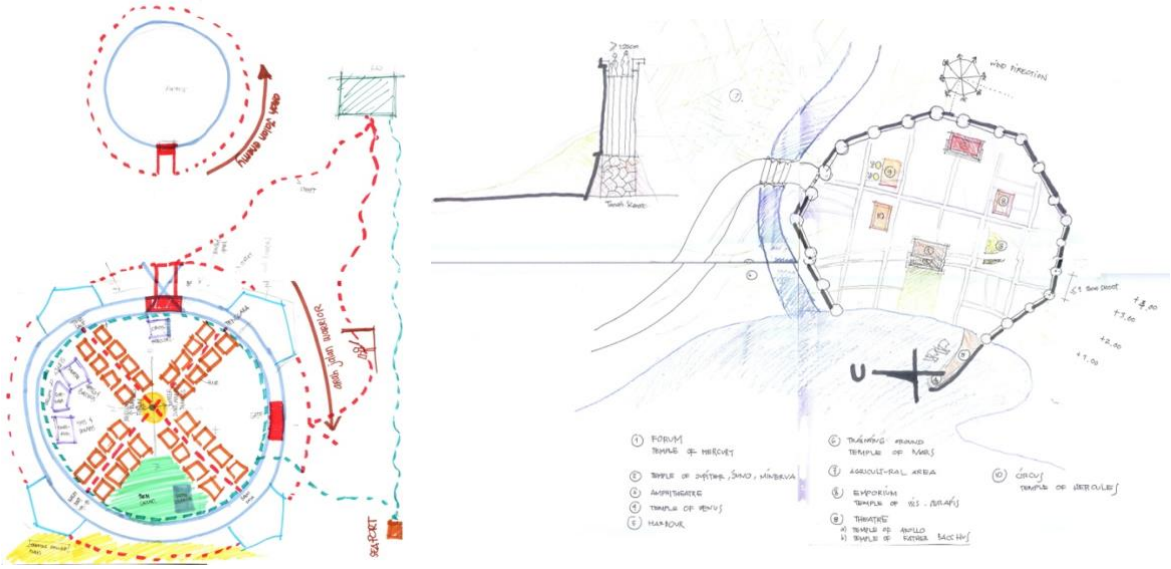
Conceptual Drawings of City Plan Based on Vitruvius' Texts Illustrating the Response to the Site Context



(Source: Students' drawings)

Figure 2

Conceptual Drawings of City Plan Illustrating Vitruvius' Prescription for Defensive Purposes



(Source: Students' drawings)

Arrangement of houses and public buildings

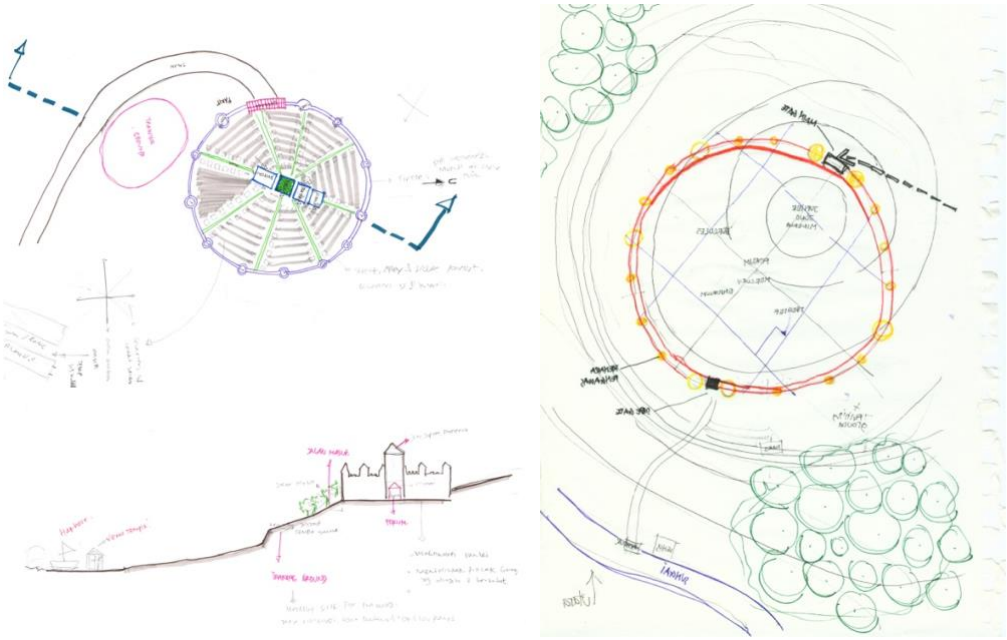
The third feature is regarding the arrangement within the city walls. All plans indicate the arrangement of the streets and houses in relation to the wind direction. However, there are some different interpretations in understanding the wind diagram provided in Vitruvius' text. In some plans, streets and houses are arranged in a radial arrangement, as in Figure 2 (right) and Figure 3 (left). Meanwhile, in some others, they are planned according to the grid aligned in a certain direction, as in Figure 2 (left) and Figure 3 (right). It seems that the radial arrangement is chosen in order to respond to different types of wind, while the aligned grid refers to certain types of wind that need to be avoided for health reasons.

In both cases—radial and aligned grid arrangement—those arrangements became the framework for positioning the houses and buildings of various functions across the city. One plan takes a different approach by positioning the streets arbitrarily (not following any radial arrangement or grid), as illustrated in Figure 4 but it seems that the positioning also attempts to avoid the direction of unhealthy winds, as mentioned in Vitruvius' texts.

Regarding the positioning of the public facilities, including temples for different gods and goddesses, the drawings illustrate the positioning that refers to the requirements as outlined in the text and in relation to the site. Some drawings illustrate how the buildings with certain functions are located following the spatial organization that has been developed within the city, as illustrated in Figure 2 (left). Some other drawings only indicate the approximate location of each function, as illustrated in Figure 3 (right). Some drawings also indicate the relationship between particular functions and the site condition, such as the positioning of certain temples in higher locations or near the harbour, as illustrated in Figure 1 (left). The drawings suggest that the texts have provided enough information to enable the decision to locate certain functions within the city and others outside the city as well as to locate certain functions in certain locations at higher or lower altitudes.

Figure 3

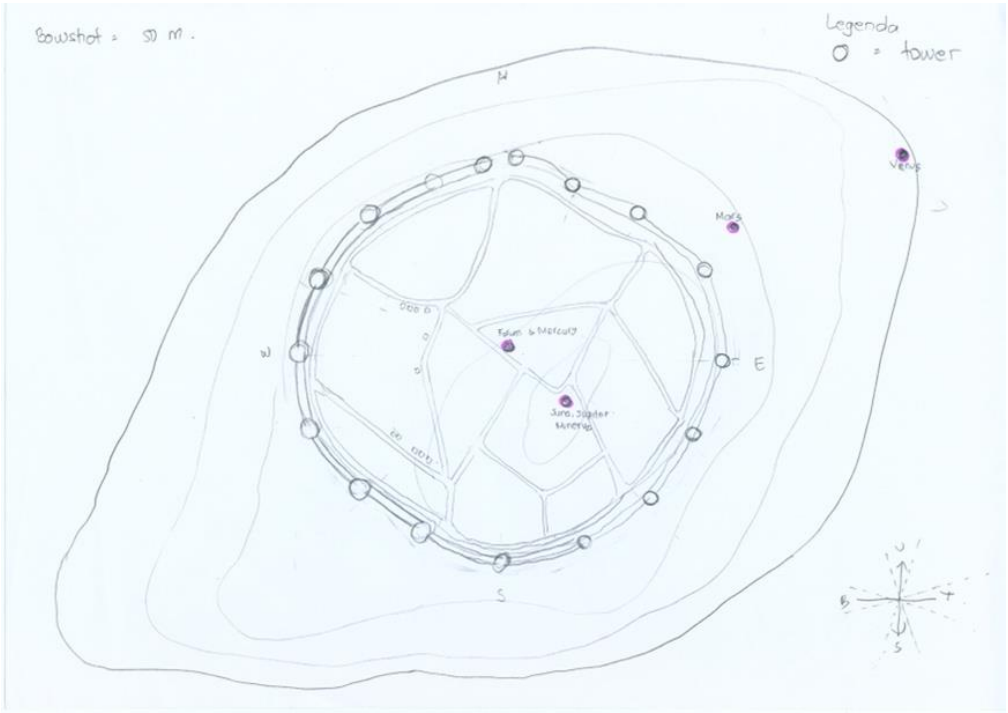
Arrangement of the Houses and Public Buildings in Radial and Grid Patterns



(Source: Students' drawings)

Figure 4

Arrangement of the Houses and Public Buildings



(Source: Students' drawings)

Rethinking Vitruvius' Methods

There is a question that emerges as a result of this planning exercise, whether the prescription provided by Vitruvius opens up any possibilities for further invention, creativity, and adjustment. To discover this, it is necessary to first examine the nature of the prescription in Vitruvius' *Ten Books*.

The text was meant to provide direction to Imperator Caesar on the methods of building. In fact, rather than summarising "accepted standard practice" around that time, Vitruvius proposed his ideas on "how architects ought to practice" (Vitruvius, 1999, p. 14) and therefore his *Ten Books* should be seen as a prescriptive text. However, the Commentary section on Rowland and Howe's translation of Vitruvius' *Ten Books* (1999) attempts to discover to what extent the prescription provided by Vitruvius was relevant to the common practice of building, before, during, and after the life of Vitruvius. The examples illustrate how the principles are found in many cities that are built, although some variations occur and not all examples adhere to the principles. The fact that Vitruvius's texts are not rigid was also highlighted by Manenti (2019), who stated that Vitruvius did not provide a strict design system but recommendations and principles that govern the way of working in design. Another study by Kashima and Kishigawa (2012) also revealed that some principles found in Vitruvius' texts later became the common key concepts of modern city design.

The exercise was done without any reference to a specific site; therefore, the outcome includes a variety of sites in the context of different natural conditions as assumed by each of the planners. Nevertheless, the principles of planning as outlined in Vitruvius' texts are rigorously followed as much as possible, producing more or less similar plans for the built environment, in this case, the plan of the city. The exercise has provided evidence that the prescription by Vitruvius may be taken as a 'method' which when followed by different planners in different contexts may yield similar results.

On the other hand, the immense variety that emerges from each plan also occurs. There has been great variety in the depth and the level of detail in applying the principles. The difference in attention to detail while referring to the prescription may provide different outcomes for the plan, with some outcomes having more details and illustrating more of the issues. There have also been varying arrangements of elements that are possible under the same principles. For example, the requirement for the positioning of the temples generally refers to the specific location in relation to the geographical condition of the site or in relation to the city position, but this, of course, opens up further variations for positioning within the boundary of this prescriptive exercise.

The design exercise illustrates the ways of interpreting Vitruvius' prescription in various features of city planning. The establishment of the circular form and the arrangement of walls and towers are the result of interpretation on Vitruvius' texts that provided effective guidelines for building city walls, including laying the foundation for the towers and the walls, and exposing the enemy to the attack from within the city. The text suggested that the enemy must be exposed to missiles from the towers on his left and right, and the roads must be laid out in a circular form to give a view of the enemy from many points. As found from the design exercise, the circular form is indeed a requirement of the city architecture to enable more views towards the enemy and the tower form to withstand the enemy's attack. The text also recommended that the towers and walls should be built in a way that offers benefits to the city against enemies approaching the town, and also allows easy movement of the army defending the city. Likewise, the students' design attempts also reveal that round towers are more durable than square towers, and that polygonal towers could be easily attacked by bowshots.

The open interpretation is also evident in the different arrangements of streets and buildings within the city walls. Vitruvius explained the different types of wind and their effects on public health in Chapter VI, and then described the arrangement of streets and buildings within the city walls. Vitruvius provided a recommendation to lay out the streets and alleys in the town according to the direction of the winds in order to avoid unhealthy windy blasts. The wind diagram provided by Vitruvius ought to be interpreted differently by different people, as evident in the subtle variations in the design outputs of the

students. Yet, generally, the radial arrangement is often chosen to respond to different types of wind, while the aligned grid arrangement is preferred to avoid unhealthy winds. Such variations indicate various possible interpretations based on a particular design prescription.

The outputs of the design exercise also demonstrate the attempt to comply with several requirements simultaneously. For example, the placement of the public buildings should comply with the requirements related to the geographical condition of the site and the convenience of the society. Dealing with several requirements simultaneously requires the ability for adjustment and reconciliation, which is often found as a challenge in modern design practice. The diagrams produced by the students indicate that the positioning of the town in relation to the natural condition of the site is important, without any reference to a specific site, thereby suggesting the flexibility of Vitruvius principles to be applied in different contexts of contemporary design.

Heath emphasized the nature of Vitruvius' methods in its ordered structure of thinking, "so that the most critical questions are answered first, and the answers to later questions are less likely to upset the results of earlier work" (Heath, 1989, p. 252). The texts were written logically and coherently, suggesting a clear order of design thinking (Manenti, 2019). The order of generating ideas in creating town plans was likely to be followed during the exercise, resulting in no unresolved conflicts between the overall plan and the detailed arrangement of streets, buildings, and other details.

Vitruvius' prescription on the planning and construction of a town was not the only one available. Throughout architectural history, there have been other prescriptions as recorded in various texts. For example, Albrecht Durer in *The Complete Teachings on Fortification of the Town, Castle and Grounds* (Evers, 2003) provided a recommendation to establish fortification based on geometrical principles. Durer's writing consists of sections on the construction of a bastion, the construction of an ideal city around a fortified residence, the circular fortress, and strengthening the fortification of the existing city (Morrison, 2014).

Another prescription was provided by Daniel Speckle with his texts and engravings of *The Architecture of Fortresses, How They Can be Built at the Present Time* (Evers, 2003). Speckle established a standard reference work on constructing fortresses, through the illustrations that contain the ideas regarding the layout and street system, and the consideration of the placement of the fortresses in different site contexts. Various requirements are outlined in both texts, some similar and some with variations. One can therefore experiment by trying to apply those requirements in the same way as by following Vitruvius' methods, and by producing both similar and varying outcomes of town planning. Another study by Kashima and Kishigawa (2012) attempted to make a comparison of Vitruvius' methods of town planning with the methods of Alberti and Scamozzi and found some key principles, such as the shape of a town and the street arrangement system, which was later also found in modern city design.

The variety of outcomes suggests the possibilities of adjustment and improvement within the range of principles that are already outlined. Rigorous application of the principles does not necessarily limit the possibilities for innovation and development in the creation of the plan. As discussed by Rowland and Howe, Vitruvius actually offered an "open" system of design, which is "a system capable of accommodating steady progress and innovation" (Vitruvius, 1999, p. 16). Vitruvius' important contribution was in offering the technical invention beyond the theoretical speculation (Patterson, 1997). Furthermore, it seems that Vitruvius himself allowed for various ideas and innovations that are not found in standard design practice. Peculiar and innovative ideas were demonstrated throughout his *Ten Books* (Vitruvius, 1999).

This may reflect the fact that architecture demands both logical reasoning and creative innovation, as also believed by Durand, in that, "Architecture is at one and the same time a science and an art. As a science, it demands knowledge; as an art, it requires talents" (Durand, 2000, p. 131). This has led us to the need to look beyond the methods outlines by Vitruvius' *Ten Books* or by any other texts. Heath suggests that Vitruvius' texts "acknowledged that no method

can be more than a guide to design; judgement would always be required in reconciling conflicting demands by mutual adjustments" (Heath, 1989, p. 252). This view suggests the need to rethink the way we see and locate methods within our design practice.

CONCLUSION

This study attempted to understand and rethink the position of Vitruvius' texts within current architectural practice and education. Through the design exercise that followed the prescription in Vitruvius' *Ten Books on Architecture,* the study reveals a lesson embedded in Vitruvius' texts, that is in the way we see the development and implication for architectural methods. Vitruvius' texts are more than merely the general prescription of the triad of *firmitas, utilitas, venustas*, but the outlining of the methods within the whole of the text may yield different interpretations and, at the same time, possibilities that we may encounter in design practice. The methods outlined by Vitruvius are definitely only ones among plenty of others, but the exercise in trying out the methods suggests that each method opens up possibilities in its own interpretation and application and therefore opens up possibilities for criticism and development.

The findings of this study suggest that it becomes necessary to continue revisiting the ideas presented in his texts—not to reject or to disagree with, but to use them as an instrument for critical improvement and continuous search for further ideas. The analysis in this study demonstrated the value of historical texts to provide a contribution to contemporary planning by offering the possibility of methods to be implemented in different contexts. This study focused on Vitruvius' texts regarding the application of city planning principles. Further explorations might be possible to examine other design methodology within the texts that addresses different types and scopes of architecture. Such exploration will enable us to explore the possible variations that could emerge from particular principles, and to incorporate both logical reasoning and creativity in design practice and education.

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