Appraising the Balance of Building Facade Over the Proportion Theory

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Abstract. The aesthetic is an enormously difficult factor to measure because of its subjectivity. It involves perceptions which everyone perceives the object differently. The golden ratio theory makes aesthetics becoming measurable aspect. In architecture, aesthetic visualization of a facade building is generally perceived subjectively. In old buildings, the theory of proportions was rigorously applied, but recently, this occurrence has degraded after the fabrication industry makes everything easier. This paper aims to measure recently constructed buildings still respect the rules of proportion. This research will be conducted by comparing the 3 colonial government buildings built in until the 1920s with 3 equivalent buildings built in the 21st century. An appraisal will be carried out through photos analysis based on the measurement of the golden ratio. The results showed that the theory of proportions with the calculation of the golden ratio, is still used by new buildings that use the Indo-European style concept, although its application is not as detailed as its calculations when compared to buildings built before the 1920s.

1. Introduction

The building facades play a very important role because it is an element which can be seen first, especially if the building has historical value [1]. Facades as a visual element will provide distinctive building, which people can give an assessment due to the aesthetic value, and distinguish it from other building characters [2,3]. Occasionally, the topic of the aesthetic in architectural theory has always been a never end subject of discussion because it deals with problems of perception, taste, and judgment [4,5]. The aspect of aesthetic assessment relates to "tastes" experience that changes along with time, place, actors and atmosphere [6]. History confirms that theories of aesthetic in architecture are gained through the proportion of building. This proportion can represent order and provide objective perceptions that felt [7,8,9]. Proportion is a way that combines elements of mathematics with art. The proportion is also one of the measurable aspects that can be used to assess the aesthetic value of a building. Proportion refers to the right and harmonious relationship from one part to another or the whole as a good unity visually. Many theories of proportions throughout history, including a) golden section; b) Regulating lines; c) technical orders; d) Renaissance theories; e) modular; f) ken; g) anthrophometry [7].

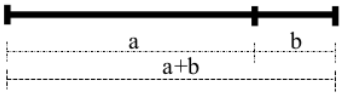
Bandung as a colonial city has many heritage buildings. However, recently, there are still new buildings designed with a contextual concept, which have a similar style to the heritage building. Many historical buildings apply the concept of aesthetic value based on the theory of proportions. The question is raised from a reflection of recent development, is the theory of proportion also applied to the new ancient-style building? The evidence of the use of proportion theory in old and new buildings

needs to be carried out. The similar research conducted by Josephine in 2016 proved the use of geometric forms, the proportion, and scale in Jakarta heritage buildings. The buildings apply the architectural theory that relay decent visual values [10].

This paper aims to identify whether old and recent buildings with old-styles use the theory of proportions based on the golden section. Exploration using the theory of proportions offers an opportunity to link understanding of the conception of ratios and proportions to geometry. The implications of the findings can strengthen the position of the golden section theory which states that all elements in nature and man-made contain beautiful proportions with 1.6 ratios.

2. Method

The issue of beauty existed since ancient times. Vitruvius and Leonardo da Vinci even stated that the object is articulated beautifully if it has the exact accuracy of symmetrical proportions between all parts of the element [11]. This research conducted to see the comparison of proportions between Indo-European-style buildings built in colonial and the current context. The beautiful proportion of elected building will be reviewed based on the proportion method of the Golden Section [12,13]. The Golden Section method does not involve elements of human feelings, culture, age, gender, etc. It is a quantitative and objective measurement tool. Golden Ratio/ Golden Number/ Golden Proportion/ Golden Mean/ Golden Section/ Divine Proportion/ Divine Section is supposed to be "beautiful" in mathematics and geometry which are irrational numbers which usually use the symbol φ and value due to 1,618033988. The digits continue to grow without certain patterns. The component a and b (with a special condition a > b) are assumed to have a golden ratio if the comparison between that two components is the same as the total ratio of the two with the maximum value. The equation a / b = (a + b) / a as in the example in Figure 1 must always meet the value of φ = 1.618. The application of golden section to geometric figures can be found not only in line's element but also in a quadrilateral, spiral and also in all existing natural forms. The Golden ratio was defined by Euclid after previously being applied by Phidias (500 BC-432 BC) in Classical Greek times to the Statue of Zeus in the Parthenon and Plato (428 BC - 347 BC). In his book, Timaeus applied the Golden Section in the discussion of natural science and cosmology [14] (see Figure 1).



$$\frac{a}{b} = \frac{(a+b)}{a} = 1{,}618... = \Phi$$

Figure 1. Examples of the application of beautiful numbers φ in line

Fibonacci series is a pattern of serial of numbers that occurs through the sum of the previous two numbers: 0,1,1,2,3,5,8,13,21,34,55,89,144,...Number φ = 1.618, also applies to Fibonacci series, if we divide one number in the Fibonacci series with a number behind it, then the golden ratio will be obtained. This is invisible at the beginning of the Fibonacci series. However, the results of the division are getting closer to the golden ratio too large numbers. The realization of the closeness makes beauty numbers used in the Fibonacci series, as seen in the Golden Rectangle, Golden Triangle and Golden Spiral. The use of beautiful numbers is also present in the proportions of the human body (see Figures 2- 5).

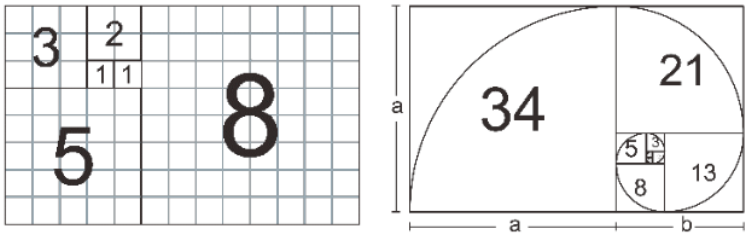


Figure 2. Golden Rectangle

The gold box is a box with proportions which are two consecutive numbers from the Fibonacci Sequence (0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144,…).

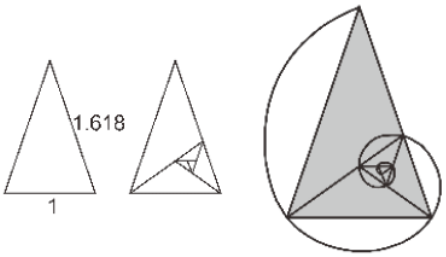


Figure 3. Golden Triangle

Golden triangle also contains beautiful numbers in the golden ratio.

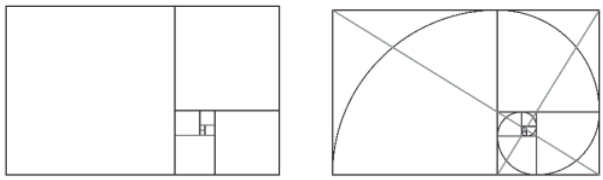


Figure 4. Golden Spiral

Golden spiral is fashioned by shaping squares side by side from Fibonacci dimension and based on quadratic pattern built golden rectangle.

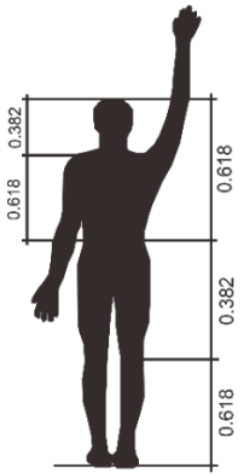


Figure 5. Human Body

Beautiful numbers are also found in the proportion of human body. Steps taken in the study include a) Selecting 3 building (see Figure 6) that were built on colonial and currently era, which built with Indo-Europian style. Three representative objects built in colonial era are Gedung Sate at Diponegoro Street, Geological Museum at Diponegoro Street and Gedung Pos Indonesia (Central Post Building) at Asia Afrika Street. Whereas 3 buildings that built recently are Gedung DPRD Jawa Barat (West Java Parliament Building) at Diponegoro Street, Gedung DPRD Kota Bandung (Bandung Central Parliament Building) at Sukabumi Street and The BJB Bank additional building at Braga Street, Bandung.

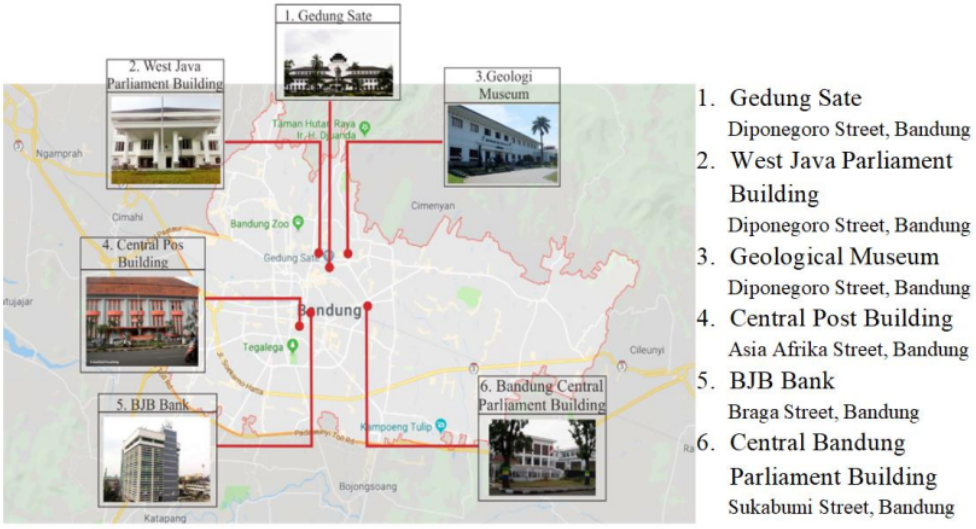


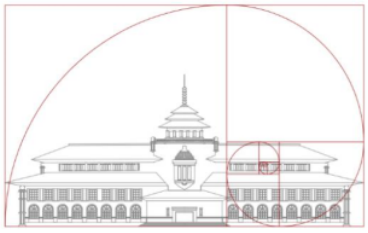
Figure 6. Map of the elected buildings position in Bandung

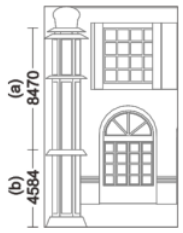
The next step is: b) Perform photography techniques by taking the frontal image angle from the front side, and must apply equally to all buildings; c) Buildings are redrawn on the same scale for all buildings; d) Take measurements with concentration on a) the composition of the size of the head-body height and the foot of the building; b) comparison of the size of building elements such as the length and width of the openings; e) Analyze the results of these measurements by comparing buildings that were built in the same era, and then compare them with other buildings built in other eras; and f) Make conclusions.

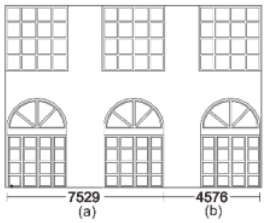
3. Results and Discussion

3.1. Indo European Style Buildings in Bandung Applying Golden Ratio Proportion

Based on the results of measurements and comparisons of an overall building in length, building height, column height, window height, the average distance between openings produces a ratio of 1.6. Three objects built in colonial era: Gedung Sate has an average ratio of 1.62, Geological Museum has an average ratio of 1.61, and Central Post Building has an average ratio of 1.61. Three buildings that built recently: The BJB Bank (additional building) has a total ratio of 1.61, Bandung Central Parliament Building has an average ratio of 1.616, and West Java Parliament Building has a total ratio of 1.63 (Figures 7-12).



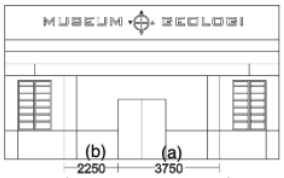


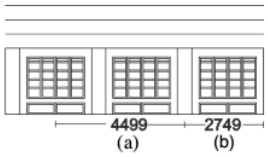


A	b	a+b	ratio
70.8239	43.594	114.13	1,61
7.196	4.584	13.054	1,64
7.529	4.576	12.105	1,60

Average total ratio = 1,62

Figure 7. Gedung Sate

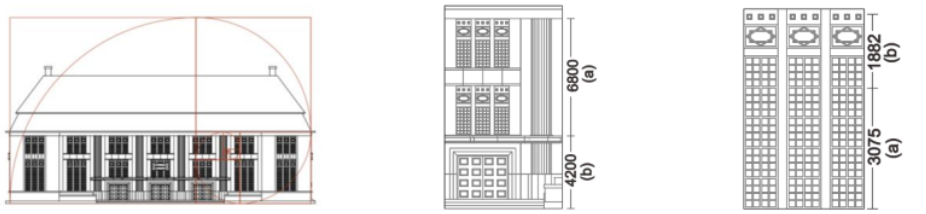




A	b	a+b	ratio
31.068	19.539	51.147	1,61
3.750	2.250	6.000	1,61
4.499	2.749	7.248	1,61

Average total ratio = 1,61

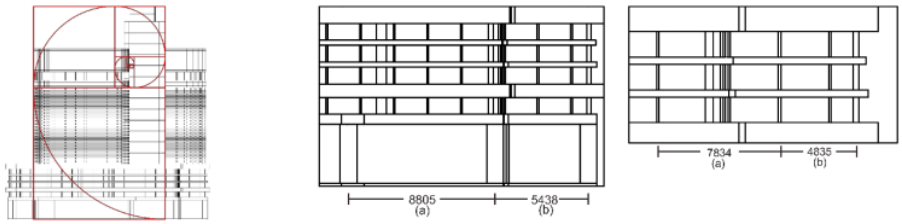
Figure 8 .Geological Museum



A	b	a+b	ratio
30.230	18.636	48.866	1,62
6.800	4.200	11.000	1,61
3.075	1.882	4.957	1,61

Average total ratio = 1,61

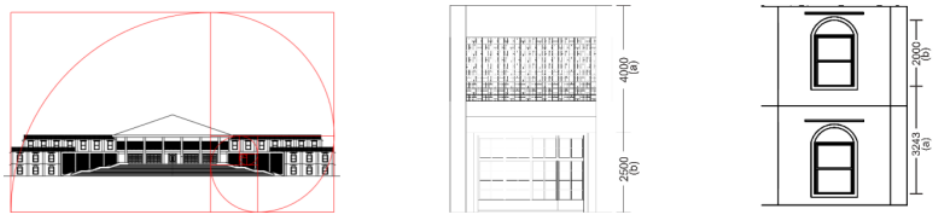
Figure 9 .Indonesian Postal Building



a	b	a+b	ratio
25.295	15.623	40.918	1,61
8.805	5.438	14.243	1,61
7.843	4.835	12.678	1,61

Average total ratio = 1,61

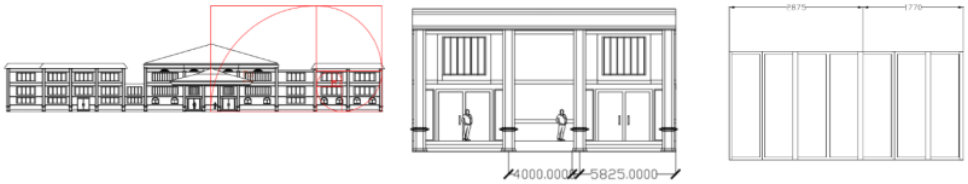
Figure 10. The BJB Bank additional building



a	b	a+b	ratio
49.164	30.392	79.556	1,61
4.000	2.500	6.500	1,62
3.243	2.000	5.243	1,62

Average total ratio = 1,616

Figure 11. Bandung Central Parliament Building



a	b	a+b	ratio
27.547	17.029	44.576	1,61
5.825	4.000	9.825	1,68
2.875	1.770	4.645	1,61

Average total ratio = 1,63

Figure 12. West Java Parliament Building

According to the appraisal of the proportion between buildings constructed in colonial-period and currently, it indicates that both periods keep using proportions by the Golden Section theory and turns out to the ratio of 1:6. In this study, the application of beautiful proportions was applied to office buildings, while the Josephine study conducted in 2016 was examined through buildings that function as landmarks. It directs that this theory actually suitable indeed due to functions requiring formal and monumental expression.

3.2. *Revitalizing Mathematics as a Tool for Design*

In the architecture realm, the Golden Section theory uses mathematics as a tool for design. Math with formulas and the unique row numbers evidently are able to provide assistance in dividing building elements and spaces, so it looks balanced, has a rhythm, unity, and proportion. However, over time, the use of mathematics as a tool design is rarely used anymore because of too many rules consideration. Now, the parametric designs emerge by using mathematics as a tool. Computers which play with an algorithm can meet the abstract design whereas it makes a design of parametric has a new challenge. Parametric design is considered as a form of a revitalization of mathematics and aid to design relevant to the context of the digital age [15]. It seems that the rule of "principle order" which are strictly applied in designing object, becoming more flexible and allowing more dynamic form though still proportional.

4. Conclusion

From the results of the analysis, the assumption that the new building does not apply the rules of "beautiful" proportions becomes inappropriate. Both new and old buildings, it turns out, expect good proportion rules, even though they are not applied in detail and complete with very accurate counts. It seems that the rules of the beauty of proportions based on the golden section have been directly attached to the application. Beauty intuition automatically uses the logic of good proportions and "accidentally" expecting magnificent numbers. The invention of this research certainly strengthens the Golden Section Theory, which the theory is still very relevant until recently. In the future, the use of the Golden Section theory will very rapidly grow through parametric design with a computer aid and produce proportional unique forms though asymmetry.

Acknowledgements

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