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The Design Method Follows Finance in Architecture

Case Study: RW 015 Office Building, Pluit, Indonesia

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Abstract

Indonesia is the largest population in Asia, with the largest community, the need for clothing, food, and shelter is higher, especially for accommodations will be more expensive, so users pay great attention to finances to design shelters. Architects must have added value in architectural design by paying attention to finance issues, so this issue is exciting to study. The methodology used in this study is qualitative with an RW 015 office building by using three indicators so that the design of the building considers finance, namely; 1) Material; 2) Structure; 3) Relation of architectural functions. The conclusion in this study is RW 015 office building, Pluit, East Jakarta, a reduction in finance was obtained ranging from 21 percent of the estimated budget. The findings in this study are a finance factor in architectural design methods is an added value.

Keyword: Architecture; Design Method; Finance; RW 015 Office Building.

1. INTRODUCTION

Indonesia is one of the countries with the largest population in ASEAN, Indonesia's population is 237.6 million according to official data from the 2010 population census issued by the Central Statistics Agency (B.P.S). Every year the rate of population growth tends to increase, and B.P.S predicts that in 2035 the population will be 315 million, with an estimated population growth rate of 1.25 percent per year. Population problems and the need for developing country housing are very closely related.

According to Maltius, this population growth will cause some problems, including the need for clothing, food, and shelter which is getting higher and more expensive. Maltius believes that the population and needs will increase as a series [1].

Economic growth is defined as a process of growth in per capita output, in the long run, public welfare is reflected in an increase in per capita output which at the same time provides many alternatives in consuming goods and services, and is followed by increasing public purchasing power [2].

The usefulness of an item will increase if it provides benefits or adds value to its original form, by producing more specific outputs by combining input sharing to create an output with a minimum cost [3].

Consumers who want to design buildings to realize the design must be adjusted to the availability of money to build. This is in line with Sukirno's view [4] which says consumers buy goods supported by financial availability to buy, taking into account the lower the price of an item, the more demand for the item. The work of architects who associate finance will make a factor of consideration for users who often continue to innovate in this era.

With the design method associated with architectural project finance, it is expected that financial use in the design of building expressions can minimize the use of finance efficiently and effectively, especially in determining the design of expressions. In Indonesia, property price developments are currently out of balance with salary increases, so that investment in property is increasingly high.

Vitruvius says: "must consider other disciplines", by studying the factors of finance disciplines in the era of information and communication technology is an added value to architectural work [5, p. 5]. If you want to design architectural works, financial factors need to be considered to provide a new architectural appearance [6, p. 240], so in this case, there is a correlation between finance and architectural design methods.

Based on the description above, this issue is fascinating to discuss concerning architecture, which has been the issue of finance with architectural design methods no one has discussed. So that the state of the art and novelty of these findings can be useful for architectural theories and also for architectural practitioners in designing buildings, that the design method affects the aspects of finance in architecture.

2. MATERIAL AND METHOD

2.1 Material

The material referred to in this research is a case study. The issue Case study is taken a financial problem, which makes a top priority in design. The expected form of the building is like a new building. Office buildings RW 015, kelurahan Pluit, kecamatan Penjaringan with an area of 264 M^2 with details, namely; 1) One hall; 2) One Pantry; 3) One warehouse; 4) One toilet; 5) One karaoke room; 6) One administration room; 7) One RW's headroom; 8) One-bedroom; 9) One security room (Figure 1).

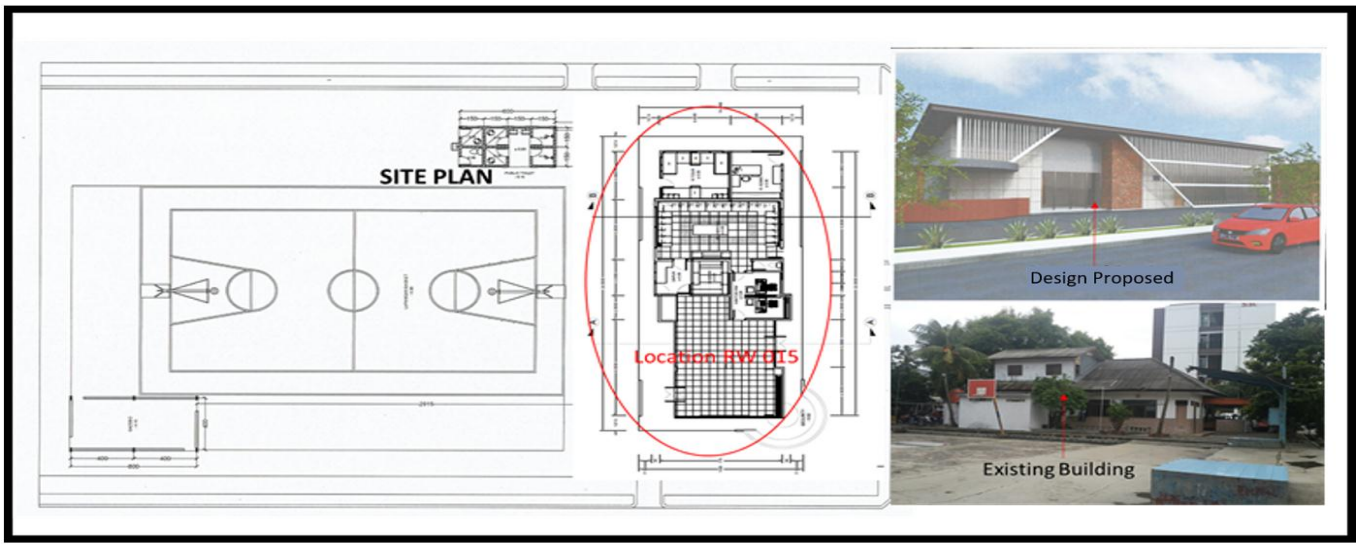

Fig. 1 Site plan, existing building, and 3D proposal design of RW 015 office building

Source: Trisno, et al., 2019 [7]

From the keyword "Design method architecture," identify that concept of architectural expression to discover aspects of architecture. The keyword "Finance" identifies the financial aspects associated with architectural design. Details of previous research searches are shown in Table 1.

Table 1. Research was examined using keywords; design and financial methods.

No	Title	Description	Source
1	Hybrid design method for wind-adaptive architecture	Building envelopes adapting to the wind play a significant role in reducing surface wind gusts and increasing the microclimate of the wind.	Sage Journal [8]
2	Methodology in architectural design	This thesis tries to examine the architectural design process. Through research on existing literature, merging architect experience, and testing theory with designers, beginners, and experts, design methodology theory.	Thesis MIT [9, 10]
3	Developing a New Method for the Architectural Design Process: An Experimental Study Using Found-Object Art in the Design Studio	The findings show that metaphors as meaning-making for idea generation and Object-Discovered Art as physical tools can provide creative tools to present ideas in tangible form. Through the analysis of design projects, it can be said that this media is a driving factor for innovative designs.	Design Journal [11]
4	A study on construction method for self-organized architecture	In this paper, the dynamic formation method of the relationship between parts and the whole is defined as self-organization. This system is designed to build apartment units as modular parts.	International Journal for Housing Science and Its Applications. [12]
6	A New Method of Human Response Testing to Enhance the Design Process	This paper presents a new method of testing human response to improve design success. Instead of waiting until after a building is built to see how the design will affect human users, we develop a high-resolution virtual reality platform to present design variations to study participants.	Proceedings of the Design Society: International Conference on Engineering Design [13]

No	Title	Description	Source
5	Research on Innovative Design Method and Application of Architectural Façade Modelling.	We learn about the essential elements of modeling design, structure shape, building details, building material innovation, material technology, and construction, structural technology innovation, and other aspects of building facades. Innovative modeling methods and design applications are expected to have certain enlightenment functions for future architectural designers in architectural innovation designs.	MATEC Web of Conferences 267. [14]
7	Integral design method for conceptual building design.	This method is intended to support the creation of building design concepts by integrating specific discipline-object-design-knowledge, based on 'knowledge space' and 'concept space'.	International Conference On Engineering Design. [15]
8	Relationship Between Function-Form in The Expression of Architectural Creation	Method design architecture based on; Form follows Function, Function follows Form, and Function and Form running together	Advance Journal [16]
9	Realization of Hybrid Concept and Symbiosis in Green Open Space (RTH) at Housing Complex RW (Neighborhood Councils) Pluit, Jakarta Utara, Indonesia	The design method uses the concept of hybrid and symbiosis between green open space and buildings.	Journal of Physics [17]
10	Financial Aspects That Drive Design Innovations for Tall Buildings	The essential component of high-rise development is the financial efficiency-profitability of the project for the developer/investor team. This presentation will focus on the financial aspects of four comparable towers in downtown Houston and Chicago.	CTBUH 2005 7th World Congress, New York. [18]

Based on Table 1, research that discusses using the keywords Design and Financial methods, in this search, no one talks. Therefore, this study aims to fill gaps that have never been examined so that the state of the art and findings obtained by this study have novelty value.

2.2 Method

This method was obtained from a literature review, in which the method of library research is grouped into two discussions, namely; 1) Design Method, 2) Financial Method. The conclusions of the two methods are used as a reading tool to analyze case studies.

2.2.1 Design methods

The architectural design method referred to here is how the expression of the architectural form to be made is; 1) form follows function, 2) function follows form, 3) each form, and function running together [16]. This design method only reviews the relationship between function and form.

This design method is to look for indicators in case studies. This indicator is used to find the relationship between design methods and financial methods.

a. Form follows function

The form follows function has long been used in modern architecture; the figure in the form follows function is Louis Sullivan. In this contemporary architecture era, architect Jorn Utzon, who designed the Sydney Opera House, published it publicly in 1958. The Sydney Opera House expresses the shape of a curved concrete roof that can reflect the Function of the Sydney Opera House, which has made building icons of Sydney city. The expression of the form of this building involved expert structural engineer, acoustics, heating experts, stage construction experts who eventually produced a form that enabled the building of the Sydney Opera House and as an icon of Sydney [19, pp. 619-620, 677].

Vitruvius in his classic book "The Teen Book on Architecture" describes *firmitas* or structure, *venustas* or forms, utilities, or functions [5, p. 17, 20, p. 8]. Vitruvius reveals that, besides the form of paying attention to structure *(firmitas),* it also follows functions (*utilitas*), so that the expressions of forms are

expected to be beautiful *(venustas).* From the description of Vitruvius, it can also be interpreted that in the Vitruvius era, besides the form has followed the function. It also gives a value of beauty.

Form expressions can also follow functions, structure, and culture, all of which can influence the form of the building [21, p. 61]. Form besides paying attention to functions can also pay attention to the local conditions of an area designed [22, p. 19]. Rob Krier in the book "On Architecture" writes, function, construction, and form are of the same value of designing architecture, there is no different priority [23, p. 227].

The form follows function in the Post Modern era has undergone quite a drastic change because, in this era, the development of structural and material technology has developed so rapidly [24]. Therefore, the concept of the form follows function has not become a significant role model anymore for architects. It is possible for function follows form, or the form and function of each running together. The form follows function is much refuted by postmodernists. For example, one function produces various forms. The form is an integral part of the spiritual level of the expression of a building. The form must be used as a medium to communicate by transmitting certain information [25].

b. Function follows form

The function can be categorized as a determinant or guide to forming. The function shows where the shape must be found. Function and form are needed to explain the architecture but are not sufficient. From the description of the function that can be used by architecture to understand the diversity of architectural function by looking at several things; 1) Architecture not only has and uses one type of function but can carry out several functions; 2) Each function can be implemented by architecture is formed from the point of view and a specific understanding of the meaning and understanding of the function used [26].

The function follows form commented by Bernand Tschumi that the concept obtains validity from changes in function, for example; schools become apartments, warehouses become retail stores, and even churches become pubs. This function argument, although not so relevant but the form needs to rely on functions so that the form becomes expressive. The relationship of these functions and forms as Tschumi said, can be possible to produce a more exciting and more satisfying architectural experience for architectural works [27, p. 146].

The function follows form can also be because of interior arrangement that affects the form of the building [27, p. 187], for example, the church at the altar requires natural light to be able to give a sacred impression to the church [28]. Thus producing an atmosphere of "silent and light" [29]. This is also confirmed by Louis Kahn that form can be manifested as natural conditions as "existence" by accompanying the play of light. So that as if to let the thing speak, namely; the light so that the light speaks for its existence to be interpreted; concrete lets concrete speak naturally and let what is done and interpreted by the observer [30, p. 288]. Still in spatial planning in the Catholic Church with the concept of "ideogram", ideograms are three dimensions of a liturgy procession to give a sacred impression to the Catholic Church by expressing the altar as the highest building, will provide an influence on its outer form [31].

c. Each function-form runs together

The condition of each function-form runs together, which is meant here, is the architectural form can be obtained from the concept of metaphor, the concept of the form of the metaphor gives the observer an ambiguous impression. The design is not ambiguous. The designer is obliged to explain the public. The concept of metaphorical form is described in the narrative or model. It can be seen from this condition that their respective function and form run independently, this, of course, begins with the function to buildings, although seen independently and separately, will eventually be synchronized to existing forms of metaphor [32, pp. 417-434].

This form was also obtained from semiotics, for example in the Villa Savoye building, where the appearance of the Parthenon shape influenced le Corbusier, so Le Corbusier designed this building for houses with the Parthenon façade concept. Here it appears that the form takes expression from the Parthenon. At the same time, the function of a dwelling house is seen in its form and function running alone, but in the end, synchronization occurs in form and function.

Forms obtained from the development of structural technology can be seen at Expo 70 in Osaka with a wide span of; 'Silk Skin', 'High Tech Tubed', 'Capsuled', 'Atrium', and 'Column-Free Building'. It can also be seen in the work of The Roger and Partners at the 'Lloyd's Insurance Office' in London in 1986. Foster Associates in 'Hong Kong and Shanghai Bank Headquarters' in Hong Kong in 1986, by Jean Nouvel at the 1987 '*Institute of Du Monde Arabe*', whose form comes from structural and material technological advancements [32, p. 186]. This opinion is also the same as the view of Thomas Thiis-Evensen in the book "Archetypes in Architecture". Saying archetype is the basis of architecture called fundamental in architecture that will not be separated from form, function, and technology; the technology referred to here is building structures [33]. While the function is an essential concept for using buildings is the basic concept of all theories, especially rational construction theory so that the building in question can be realized and used according to the architect's concept [27, p. 166].

Based on the review of architectural design methods, that form can follow function, or function follows form, and or each function-form runs together. From this description, it can be concluded that the form follows function, or function follows form, and or each function-form runs together, all of which must be able to be architecturally sublimated efficiently and effectively to be able to express the form of the building. Admittedly, in this era, there was not one valid concept, whether form follows function, function follows form, and or each function-form runs together to be a guideline for design [27, 34, 35, 32].

The theoretical study of architectural design methods that can be indicators that influence the expression of architectural form is; Materials, Structure, and Optimization of function-form relationships.

One example of material indicators that can affect the expression of architectural forms can be seen from Frank Gehry's work at the 'Bilbao museum' in Spain, Titanium material reveals the form of this building. Additionally, the steel frame structure supports the expression of Titanium material. The work of Jorn Utzon at the Sydney Opera House expressions form derived from a concrete roof structure that causes this building to become an icon of the city of Sydney. Optimization of the relations of architectural form follows function can be seen in Frank L Wright's work in the design of the 'Guggenheim Museum' in Manhattan. The relationship of the ramp building form that is used as a function of this museum, it turns out the use of the interior is very efficient and effective so that this building is very famous and also visited by many people both architects and not architects.

2.2.2 Finance methods

Alfred Marshall's opinion assumes that market prices are acceptable if they are following what is offered. The price approach should be reasonable so that it can be accepted by the community [10]. Jean Charles Sismondi said that general competition would produce goods whose production quality must be as good as possible, but the price of the product must be reasonable [10, p. 79]. The timing of the building is related to financial issues. This greatly affects economic performance [36, p. 12]. Here there is a relationship between economic performance and building finance.

Economic value added (EVA) is a measure of financial performance that most clearly illustrates the actual economic benefits of a company, compared to other standards [37]. Economic added value can be used to identify and evaluate the rate of return of activities or projects [38]. An efficient market consists of rational and active players pursuing maximum profits, competing to predict market value to create stability in the future. Essential information about the product is freely available to all market participants [39, p. 210].

Based on the views of Stewart, Mirza, and Kuncoro, expressing forms that can win the market must have an economic value-added so that the expressed form does not spend too much on finance, but the design is still attractive. It means that financial problems, when connected with architectural design methods, must pay attention to efficiency and effectiveness. The use of building elements up to the finishing of the building, which includes work: 1) Building Foundation Structure; 2) Building Structure; 3) Floor; 4) Wall; 5) Ceiling; 6) Roof; 7) Utility: 8) Material Finishing (see Table 2) [40].

This essay is following Luis Sulivan's 1896 work on modern architecture. At that time said that "form follows function" as an argument in commercial architecture, where the function of a building is to make sense in financial design. The best axiom for designing skyscrapers is to pay attention to financial and architectural forms (Willis, 1995, p. 163). This axiom is also almost in line with Buckminster Fuller's view that the freedom of architecture to find architectural innovation does not forget its relevance to financial problems [35, p. 450].

The Empire State Building skyscraper with a height of 1,250 feet and 102 floors was opened on 1 May 1931 in Midtown Manhattan with an architect; William F. Lamb, Arthur Loomis Harmon, and Shreve, these buildings are the tallest building before the building of the World Trade Center [41, p. 426].

In 1929, John Jacob Raskob was a finance executive and businessperson for DuPont. General Motors and builder of the Empire State Building made a finance simulation if this building was designed with a height of 80 floors with a total income of USD 6,300,000. With gross returns of 12.6%, then estimates for office rental for towers is USD 4 per square foot and USD 3.25 per square foot, which is not a tower while operating cost is USD 75 per square foot, so it looks very expensive operating cost [42, p. 167].

It is the basis of consideration for essay architect Louis Sulivan in the generation before the baby boomers. In the era of the baby boomers before the Empire State Building was still built, it was estimated that in that era the awareness of finance had not yet become a necessity, because in the 1931 era the highest building icon was prioritized.

Table 2 is a table sourced from the State Building Technical Guidelines on the cost of building standard works. This table has been modified to be used as an indicator tool to read case studies.

Table 2. The cost of building standard works from the Minister of Settlements

No	Building Element	Percentage
1	Building Foundation Structure	5% - 10%
2	Building Structure	25% - 35%
3	Floor	5% - 10%
4	Wall	7% - 15%
5	Ceiling	6% - 8%
6	Roof	8% - 10%
7	Utility	5% - 8%
8	Finishing Material	10% - 15%
	Total	**100%**

Source: State Building Technical Guidelines [40]

From Table 3, building elements can be grouped into; a) Structure including Building Foundation Structure (1) and Building Structure (2); b) Materials including Floor (3), Wall (4), Ceiling (5), Roof (6), Utility (7) and Finishing Material (8). Indicators of reading devices related to finance can be grouped into two parts, namely: 1) direct effects on finance and 2) indirect effects on finance. The direct effects are material and structure (See Table 3.) while the indirect ones are optimization of function-form relationships which are the total of the whole

(100%) of Table 3.

Table 3. Indicator as a case study reading tool

No	Description	Building Element	Percentage
1	**Structure**	Building Foundation Structure	5% - 10%
2		Building Structure	25% - 35%
3	**Material**	Floor	5% - 10%
4		Wall	7% - 15%
5		Ceiling	6% - 8%
6		Roof	8% - 10%
7		Utility	5% - 8%
8		Finishing Material	10% - 15%
		Total	**100%**

This reading tool for analyzing case studies is referred to as a research method. This research method is derived from financial methods, and architectural design methods, all of which are to get added value with the intention that the architect's design work is adjusted to finance so that expressing architectural works that are efficient and effective towards finance. Indicators needed to analyze case studies; 1) What materials are used to be efficient and effective in finance; 2) What structure is used so that it is efficient and effective in the financial sector; 3) Optimization of functional relationships with efficient and effective use of space.

2.3 Case study

The material intended in this study is a case study that will be analyzed with a reading instrument from the research method obtained from a theoretical study, the case study is the RW 015 office building in Pluit. This study was evaluated from the expenditure of funds issued for the building implementation compared to the estimated funds made previously.

RW 015 Office Building in Pluit, Jakarta, Indonesia, was held in 2018. The office building is an office that is used for residents of residential complexes, RW 015 office building consists of 13 RT (*Rukun Tetangga*), 1 RT is less than 50 heads of families. So RW 015 office building is less than 650 families.

The RW 015 office building development is a fund from the RW 015 community, so the factor of finance in the design of this building is very much considered, all the design of this building is based on RW 015 cash flow. The area of RW 015 office building is 264 M^2 estimated that the budget for 2018 is USD 288. Per Square Meter, so the total is USD 75,971. Based on the calculation of the implementation of buildings in the field, the total funds issued by paying attention to the issue of finance is USD 60,065. It means a reduction in funds of 20.8% (from estimated funds) rounded up 21%.

Based on these case studies, trying to analyze any factors, so that this building can reduce funding from building finance, the reduction in investment is highly dependent on which country data are made, in this case taking data from the country of Indonesia. Although the data is different from other countries, the principle carried out in the design method is associated with financial problems can be said to be almost close. This case study has actual business data that are quite complete because this data is based on the executor of the building so that this case can be further analyzed according to the research method.

3. RESULTS AND DISCUSSIONS

3.1 What materials are used to be efficient and effective against finance?

In the design of the RW 015 office building, the use of existing building wall materials is optimized so that financial savings can occur to be effective and efficient. Part of the design of the RW 015 office building is made of new material (from Table 1, there is only a reduction of about half of the wall percentage of 7.5%). Conversely, roofs, floors, doors, and windows are also made with new materials that match the expression to be achieved. RW 015 office building wall materials are not as maximum as the use of the wall materials. Of course, this will affect the finances of the buildings, so the utilization of RW 015 office building wall materials is less (See Figure 2; Existing wall).

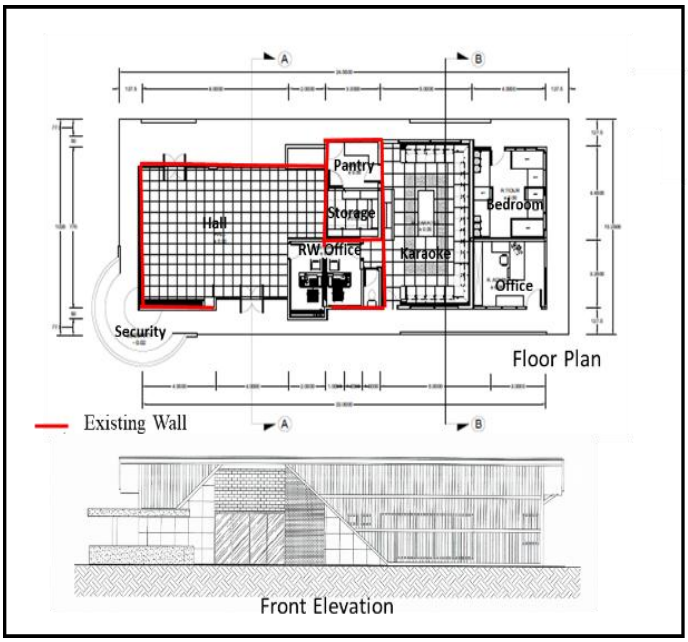

Fig. 2 Floor plan and front elevation of RW 015 office building

Source: Trisno, et al., 2019 [7]

3.2 What structure is used to be efficient and effective against finance?

In the RW 015 office building, the use of existing structures is not much utilized. It turns out that the new structure is more dominant; this is because there is an increasing need for space from the existing requirements so that there is additional space coupled with the needs of building structures. The added building structure includes foundations, columns, and beams to hold the roof plan. The old column in the existing building is maintained to save finance (From Table 1, it is estimated that there is a slight reduction in the structure of around 13.5%).

Based on the analysis of the building structure indicators, it can be said that RW 015 office building is relatively budget higher. Suppose the RW 015 office building is made into two floors. In that case, the financial expenditure will be even higher because the structure of the existing building cannot be used anymore; it must be completely dismantled. The design of the RW 015 office building is an additional extension to the horizontal direction, with the expectation of lighter financial expenditure than the addition to the vertical (high rise building). This step aims to reduce the financial funds for the RW 015 office building (Figure 3).

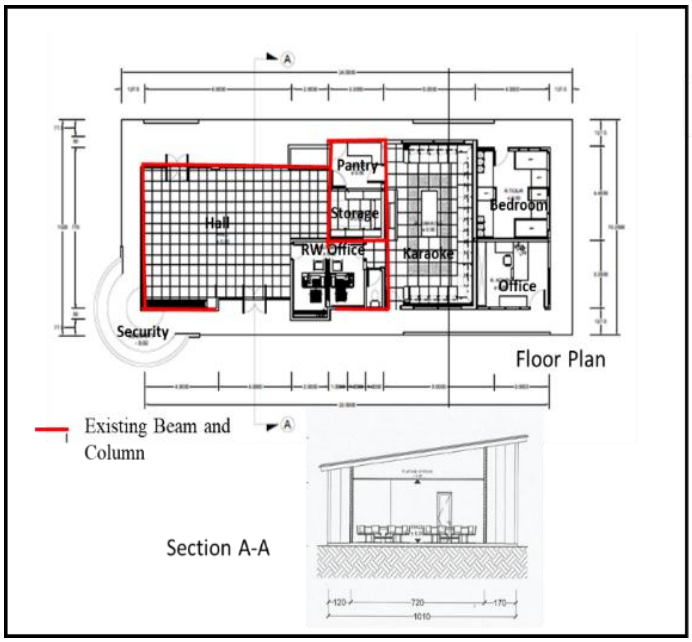

Fig. 3 Floor plan and section of RW 015 office building

Source: Trisno, et al., 2019 [7]

3.3 Optimization of function-form relations with efficient and effective use of space in finance.

RW 015 office building expresses its form according to its function; the use of space is adjusted to the needs of the area requested. The existing building is unable to meet the development of space requirements that exist at this time. The development needs to adjust the time so that these existing buildings need to be rearranged to match the era. The addition of building to the horizontal direction must be able to express the form adapted to the use of space functions in the RW 015 office building. The use of space in the RW 015 office building has been used optimally so that the shape of this building has been efficient and useful (Fig. 4). There was a request from the head of the RW 015 office building for the exterior lattice that functioned as a sunscreen to be removed because using the funds was quite large, so the funds were allocated for interior work.

Fig. 4. RW 015 office building before and after being designed, exterior and interior view

Source: Trisno, et al., 2019 [7]

Based on the analysis of the three indicators, a table is made which summarizes the three indicators based on the case study analysis with the following description (Table 4):

Table 4. Range of indicators in case studies

No	Indicator	RW 015 Office Building	Explanation
1	Materials	Semi Optimal (7.5%)	RW 015 office building use semi-optimal materials
2	Structure	Semi Optimal (13.5%)	RW 015 office building uses a semi-optimal structure
3	Optimization of Function-form Relations	Optimal (100%)	Both are optimal

Based on table 4, the optimization of the RW 015 office building. It can be ascertained that the RW 015 office building, this is following the data provided by building executors, that RW 015 office building has 21% (7.5% + 13.5%) finance savings

4. CONCLUSION

The design method follows finance used as the design for architectural form expressions, should pay attention to the indicators of material, structure, and optimization of function-form relations so that the architectural design can save finance to the fullest. Based on the analysis of this case study, it is concluded that the use of this indicator can produce significant financial statements. The indicator details are described as follows; 1) The material used must utilize the potential of the surrounding and existing buildings; 2) The structure of the building uses the current building structure; 3) Optimizing the design of the use of space so that space is efficient and effective. At RW 015 Office, 21% has a cost reduction of budget.

This paper cannot build new buildings without eliminating the potential for existing buildings to be redesigned, even though architects are given the opportunity to freely design buildings. However, using financial design methods is very profitable for building owners.

The findings in this study are that architects can design creatively. Still, on the one hand, they also have the opportunity to choose their work, whether to demolish all existing buildings or try to utilize existing buildings to be rearranged into expressions of new buildings following the financial, because in architectural design pay attention to financial factors as an added value in the design method. In the previous era, this problem was unnecessary, but in the current period, it has become a consideration factor for choosing an architect.

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