

Connectivity and Energy Efficiency Applications in Apartment

Afrillia Ratna Ferenitha¹ Maria Immaculata Ririk Winandari^{1,*} Sri Handjajanti¹

¹ Architecture Department, Universitas Trisakti, Jakarta, Indonesia

*Corresponding author. Email: mi.ririk@trisakti.ac.id

ABSTRACT

Apartment with compound buildings require good connectivity and energy efficiency. Both elements are needed for function optimalization. the Apartment design in certain locations requires comprehensive field data. In the pandemic situation, the difficulty of conducting field trips can be solved through digital surveys. This paper aims to show the process of implementing connectivity & energy efficiency in the apartments design in Bekasi that are done digitally. The descriptive qualitative method is used for this research. The variables consist of layout, lighting, and water filtration. The results showed that there are two things that need to be noted related to the application of connectivity and energy efficiency. The most appropriate use of digital applications for both connectivity and energy efficiency design are Photoshop program. The AutoCAD program makes it easier to implement connectivity in the design while the SketchUp program to implement energy efficiency.

Keywords: Covid-19, Digital, Energy efficiency, Connectivity, Apartment.

1. INTRODUCTION

In times of pandemics, when humans spend more time at home, housing design should take energy efficiency and comfort into account. Energy use, previously partly used at work or school, is now nearly 24 hours a day spent at home. Therefore, the housing design should take into energy efficiency especially for light, water, as well as electricity to alleviate the occupants' costs. The comfort of residents while living in their dwellings is another thing that must take precedence. The making connection principle that applied in apartment design could increase the residents' comfort especially if it integrated with other functions. Apartment with compound buildings require good connectivity and energy efficiency for function optimalization. The design requires comprehensive site's data [1].

Architectural design in the situation of the covid pandemic has challenges related to site observation and design process. Site conditions are very important in the design process. Movement restrictions in various regions make site observations difficult to do directly. The need for data is anticipated using digital technology. For site observations data, it was done through Google Maps and Google Earth applications. These application shows the condition of 3-dimensional

sites virtually as well as searches for secondary data or archives online. For design process, other applications such as photoshop, AutoCAD, and SketchUp were used to apartment design. This paper explains the advantages and disadvantages of using digital technology applications in the process of implementing connectivity and energy efficiency in designing apartments.

2. LITERATURE REVIEW

2.1. Digital Technology on Data and Design Process

The first step that must be done in building design is the data collection related to the site conditions and the regulations that apply in that place. The data includes location maps, territorial boundaries, public transportations, transit locations, sun orientation, and local regulations. The data that previously had to be obtained directly through site visits was currently forced to be done by Digital Technology. The use of google earth application to get the site conditions has been widely done by researchers and other building designers [2]. The next step is an analysis based on data whose results are used as a basis for designing buildings and environments. All steps used technology applications in the process. This digital applications were used to obtain

the data, to facilitate the analysis, as well as to visualize the design [3].

2.2. Connectivity and Energy Efficiency

A good building is the one that connected to other buildings or functions in the vicinity. the connectivity can be done through the layout with easy access among buildings or functions. Green open space placement in the middle of the building massing is solution to create efficiency and comfort. Connectivity can be applied to ease the access from one building to another [4].

Energy use in buildings is dominated by climate around buildings. This is caused by infiltration heat approximately 50-80% that generated from the building facade. Currently, building designs should apply the energy efficiency principle. This applied through openings with cross ventilation systems and the use of solar panels. Ventilation and lighting designed to make a healthy and comfortable building [5]. This can be done through a good ventilation, lighting, and acoustics. Related to light and wind, the building layout should be attempted in the middle of the site so that all building sides can be exposed by direct wind and sunlight. Window openings should use a live ventilation system, tried as wide as possible to give the wind flexibility to move in the room, but protected from direct sunlight that can heat the room.

3. METHODS

The method applied to this study is qualitative research. Based on Septika [6], architectural images were used as a basis for explaining the process for implementing the architectural principles that are done digitally. Research is done through 3 steps: collecting data, conducting analysis, and drawing conclusions. Data analysis processed from the advantages and disadvantages of using digital applications during the layout, lighting, and water design process. Digital applications consist of AutoCAD, SketchUp, Photoshop, Lumion, and Enscape. The applications were used when collecting data, analysis, and visualization [3]. Comparison among digital applications in designs process followed by discussion with other theory.

4. RESULTS AND DISCUSSION

Apartment with connectivity and energy efficiency design requires comprehensive site's data. In the time of pandemic, conducting site's data can be solved through digital surveys. These data consist of maps, regulation, borderline, public transport, transit location, sun orientation. The other process such as analysis and design were used some digital application that varied in each process. Here is a discussion about the advantages and disadvantages of using digital applications in

implementing a good connectivity and energy efficiency designs.

4.1. Connectivity

The connectivity principle was applied through the placement of an open space in the middle of several buildings and a bridge that connecting commercial area and LRT station. The open space surrounded by 5 apartment buildings and 1 commercial building. This space serves as a connecting area to each building as well as an interaction area for residents. As stated by Zhang et al. [4], this space is expected to facilitate the residents movement from one building to another. In line with that, the bridge that connected between commercial area and LRT station will make LRT users easier to visit Malls and apartment and vice versa. Figure 1 shows the open spaces and bridge layout in site plan.

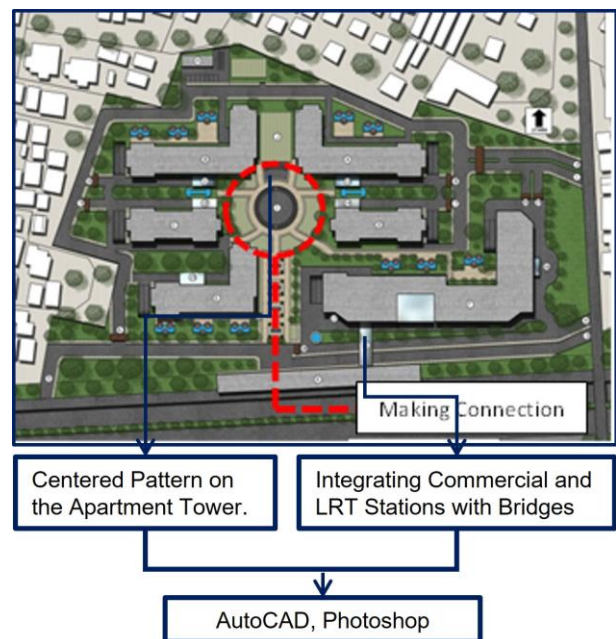


Figure 1 Connectivity through open space and bridge.

AutoCAD and Photoshop applications were used to design and to visualize the layout. In this process, the use of AutoCAD was very valuable because the process becomes simpler and scalable. This condition is in accordance with other research [7–10]. On the other hand, this application does not support the design appearance visually. The use of Photoshop in this process could make the visualization more informative and interesting. A previous statement Maziar and Sirous [11] was reiterated in this case. Nevertheless, too many tools in Photoshop cause the drawing process to be more complicated.

4.2. Energy Efficiency

Energy efficiency principle was applied through façade openings, solar panels, and water filtration design. First, openings are optimally designed to reduce artificial light and air conditioning. Large windows are placed in a certain position with cross system to optimize natural lighting and natural ventilation. As stated by Zhang et al. [4] this design could make a healthy and comfortable building. The heat caused by large window openings, especially on the East and West sides was reduced by using a secondary skin design on the façade. Figure 2 shows façade with secondary skin design.



Figure 2 Façade with secondary skin.

Secondly, solar panels are placed on the building's roof for optimizing the sunlight absorption and converting it to electrical energy. Figure 3 shows the solar panels placement on the apartment's roof.

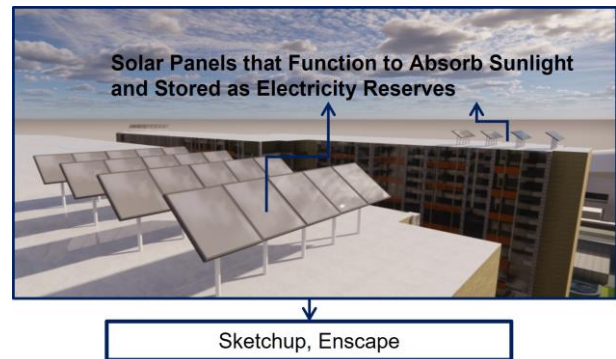


Figure 3 Solar panel in apartment's roof.

The digital application applied to visualize the openings and solar panels were SketchUp, Lumion, and Enscape. SketchUp application was used for visualizing opening with secondary skin and Solar Panel placement. This program makes the design more interesting and clearer with a 3-dimensional image. The 3-dimensional displays are easier to see even though the visual result has not been as expected. Referring to Yong et al. [12], SketchUp provide a more realistic image for a 3-dimensional image. In line with Maina, Ramadhanty and Handayani [7,13] that SketchUp is useful for the 3-dimensional process. On the contrary, Huang et al. [14] stated that SketchUp ignores the effect of design and late expression.

Lumion program was used to patch the visual lacking from SketchUp program. The advantages of this program were the best image information and visualize in 3-dimensional images. In line with Ramadhanty and Handayani [13] this program made the image more realistic. On the other hand, in contrast to Ramadhanty and Handayani [13], this program takes longer during the rendering process (see Table 1). Enscape program added to clarify the image of solar panels because of its virtual reality although it difficult when going to make a 3D film.

Thirdly, water filtration was designed to applied energy efficiency principle because of clean water demand. Rainwaters' filtration was used to minimize the use of groundwater for toilet flush as well as for watering plants in the large area. Figure 4 shows the water filtration layout and scheme in the apartments. AutoCAD and Photoshop programs were used to visualize the water filtration that placed in the open space. The AutoCAD was useful because of its simplicity and its scalability even though the visual appearance was less supportive. The addition of Photoshop program is done for a better visualization even though more complicated.

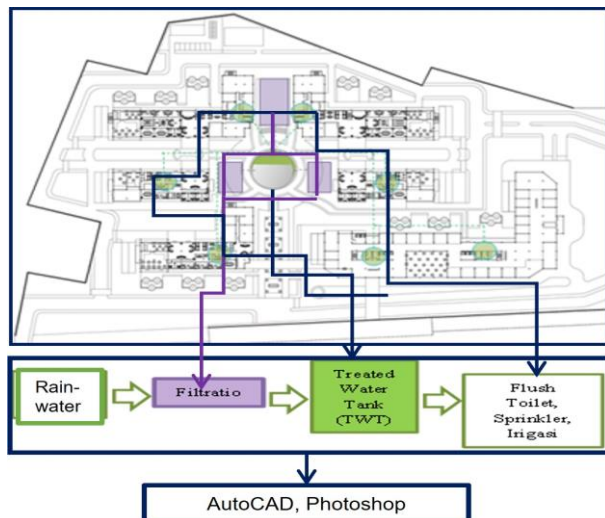


Figure 4 Water filtration scheme.

The following table shows the comparative advantages and disadvantages among digital programs that were used to visualize the connectivity and efficiency energy (see Table 1).

Table 1. Advantages and disadvantages

Variable	Advantages of Applications for Design and Visualization		
	Layout	Lighting	Water
<i>AutoCad</i>	Simplicity, More scale able	-	Simplicity, More scale able
<i>SketchUp</i>	-	Attractive, more realistic	-
<i>Photoshop</i>	More Informativ e	-	More Informativ e
<i>Lumion</i>	-	Image information in 3D and Visualize	-
<i>Enscape</i>	-	Virtual Reality	-
<i>AutoCad</i>	Drawings cannot explain visually	-	Drawings cannot explain visually
<i>SketchUp</i>	-	Ignore the result	-
<i>Photoshop</i>	Too many tools	-	Too many tools

<i>Lumion</i>	-	Longer to render	-
<i>Enscape</i>	-	Has its drawbacks when it comes to designing 3D films on buildings	-

5. CONCLUSION

Based on the use of digital applications in designing apartments in Bekasi, there are two things that need to be noted related to the application of connectivity and energy efficiency. First, the most appropriate use of digital applications for both connectivity and energy efficiency design are photoshop program. This program can be used to visualize the centered pattern layout, the bridge, as well as the water filtration in open space. Secondly, the AutoCAD program makes it easier to implement connectivity in the design while the SketchUp program to implement energy efficiency. The AutoCAD can be used to design the centered pattern layout with public open space as center and the bridge connecting the commercial with the light rail station. The SketchUp can be used to visualize the solar panel on rooftop and secondary skin in East and West side.

REFERENCES

- [1] F. Can and D. Keywords, "Location Based Data Representation Through," *Int. J. Archit. Res.*, vol. 12, pp. 228–45, 2018.
- [2] F. Petrovič, M. Boltžiar, I. Rakytová, I. Tomčíková and E. Pauditšová, "Long-Term Development Trend of the Historical Cultural Landscape of the UNESCO Monument:" *Vlkolánek (Slovakia) Sustain.*, vol. 13, pp. 1–20, 2021.
- [3] Q. Asghar, A. Jalil and M. Zaman, "A catalog of Urban Interventions: Investigation through Digital Design Architecture Studio Pakistan," *J. Eng. Appl. Sci.*, vol. 29, pp. 22–34, 2021.
- [4] Z. Zhang, S. Meerow, J.P. Newell, and M. Lindquist, "Enhancing landscape connectivity through multifunctional green infrastructure corridor modeling and design," *Urban For. Urban Green.*, vol. 38, pp. 305–17, 2019.
- [5] K.H. Han and J. Zhang, "Energy-saving building system integration with a smart and low-cost sensing/control network for sustainable and healthy living environments: Demonstration case study," *Energy Build.*, vol. 214, pp. 1–22, 2020.

- [6] D.A.K. Septika, "Image-making and Architecture: A Digital Medium for Qualitative Design Representative," *Built Environ. Stud.*, vol. 1, pp. 29–36, 2020.
- [7] J. Maina, "Cad and Bim in Architecture Education : Awareness," *Proficiency J. Sci.*, vol. 6, pp. 167–78, 2019.
- [8] N.M. Aljamali and J.R. Moslim, "Review on Designs for AutoCAD Programs and Its Chemical Applications," *J. Digit. Integr. Circuits Electr. Devices*, vol. 6, 2021.
- [9] M. Fakhry, I. Kamel and A. Abdelaal, "CAD using preference compared to hand drafting in architectural working drawings coursework," *Ain Shams Eng. J.*, vol. 12, pp. 3331–8, 2021.
- [10] A.Z. Onur and F. Nouban, "Software in the architectural presentation and design of buildings: State-of-the-art," *Int. J. Innov. Technol. Explor. Eng.*, vol. 8, pp. 2723–9, 2019.
- [11] S. Maziar and B. Sirous, "Introducing the Innovative Course of Architecture Modeling and Rendering (R.S.V.P)," *J. Res. Sci. ,Engineering Technol.*, vol. 5, pp. 1–5, 2019.
- [12] S.De. Yong, Y. Kusumarini and P.E.D. Tedjokoesoemo, "Interior design students' perception for AutoCAD, SketchUp and Rhinoceros software usability," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 490, pp. 0–12, 2020.
- [13] D.M. Ramadhanty and T. Handayani, "The Effect of Computer-Based 3D Visualization," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 879, 2020.
- [14] K. Huang, J. Wang, D. Lin, and Y. Liu, "Application of Google SketchUp in Tourism Planning - In Case of Heilongjiang Ning'an Jiatai Manor," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 466, 2018.