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TIM PENGUSUL :

Ketua :
Dr. Ari Widyati P, S.T, MATRP, IAI
NIDN : 03.030172.01
Anggota :
Saeful Bahri, ST., MT
NIDN : 03.260576.04

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HISTORICAL ATTACHMENT OF COLONIAL BUILDING THROUGH COMMUNITY PERCEPTION: CASE STUDY OF MUSEUM FATAHILLAH, KOTA LAMA JAKARTA

Ari Widyati PURWANTIASNING[1], Saeful BAHRI[2]

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ABSTRACT:
This study aims to identify the extent of the historical attachment of colonial buildings in conservation areas, especially in the Old City of Jakarta. This research is part of a multi-year study that examines historical attachments in conservation areas as the main topic and discusses several case studies. Fatahillah Museum has been taken as a case study which located in the Old City area of Jakarta. The idea of this research is based on the existence of social and cultural phenomena in the community concerning conservation of architecture for historic buildings. The community in Jakarta as a metropolitan city has a direct impact on the implementation of the concept of building conservation. By digging up information from literature and old archives of historic buildings in Jakarta Old Town, as well as collecting data and explained using descriptive qualitative analysis, case studies can be described thoroughly. The results of this study through community perceptions turned out to be able to present a historical level of attachment to colonial buildings, especially the Fatahillah Museum in the Old City District of Jakarta.

Key-words: *Historical attachment, Historical buildings, Fatahillah Museum, Community perception, Architectural conservation.*

1. INTRODUCTION

Jakarta Old Town has been regarded as an area of urban heritage in Indonesia which has suffered from the impact of globalization. One of the efforts from the government is to preserve and conserve all historic buildings within the area. The aim is to enhance and upgrade the quality of the historic buildings themselves. Jakarta Old Town District has many historical old buildings within it, from Masjid Luar Batang, Museum Bahari, Pelabuhan Sunda Kelapa, Jembatan Kota Intan, Toko Merah, Museum Bank Mandiri, Museum Seni Rupa dan Keramik, Pasar Ikan, Menara Syah Bandar, Galangan VOC, Stasiun Beos Kota and Museum Fatahillah (**Fig. 1**). This paper will not discuss all the above historical old buildings but will explore just one of the significant historical old buildings within Jakarta Old Town District (**Fig. 2**) shows the zoning of Jakarta Old Town District). The significant historical building within Jakarta Old Town district chosen is Fatahillah Museum which has been known as Jakarta Historical Museum. Fatahillah Museum is located at Jalan Taman Fatahillah No. 1, Jakarta and had been used as The City Hall for The VOC in the colonial era (Stadhuis van Batavia).

The local government of Jakarta has designated the Stadhuis as Fatahillah Museum, to preserve the existence of this historical building. By adapting to its new use as a museum,

[1] *Universitas Muhammadiyah Jakarta, Department of Architecture, Jalan Cempaka Putih Tengah 27, Jakarta Pusat, Indonesia, arwityas@yahoo.com*
[2] *Universitas Muhammadiyah Jakarta, Department of Electrical Engineering, Jalan Cempaka Putih Tengah 27, Jakarta Pusat, Indonesia, saefulbahri2003@yahoo.com*

this building can be maintained continuously, and it enables sustainable memory from the past for the next generation (Culture and Museum Office, 2007).

Fig. 1. The Museum Fatahillah under renovation (Purwantiasning, 2015).

This article is a part of research with more than one case studies, with an exploration of some case studies to support the research in answering the question of the study. The idea of this research is based on the existence of social and cultural phenomena within the community concerning historical buildings as well as the historical area. In this case, using Jakarta Old Town District as a case study, the research explores by involved digging out of the information, from archives, documentation and local community perceptions about the existence of historical buildings as well as the historic area, and the impact of the implementation of the concept of conservation and revitalization.

2. STUDY AREA AND DATA

Fatahillah Museum is located in Jakarta Province, which is known as an area of Jakarta Old Town. This building used to know as a Stadhuis van Batavia in the colonial era. The Governor of the Dutch used to operate this building as a Governor Office. Figure 2 shows that within Jakarta Old Town District, many colonial buildings have been conserved by the local government of Jakarta. Some of them have been conserved entirely, some of them are still under construction, and some of them still remain the same (the condition is abandoned because of lack of utilities).

Physically, the area of Museum Fatahillah is an area consisting of buildings with colonial architecture (Dutch style). The buildings and area to Jalan Pinangsia have very significant character and are about a hundred years old. According to the history of all the buildings, they have significant history and from past to present, the function of those buildings have been changed from time to time, following the needs of the market. The local government (DKI Jakarta Local Regulation,1999), has been encouraged to maintain all the buildings using their budget for the sustainability of The Jakarta Old Town District which has become a very significant part of the identity of the city.

Fig. 2. The area of the Museum Fatahillah (Purwantiasning, 2015).

One of the most significant buildings within The Jakarta Old Town District is The Museum Fatahillah, which has been known as the Historical Museum of Jakarta (Figure 1). This building used to function as The City Hall of The Dutch in The Colonial Era. The character of the building has been maintained to remain the same, and this is to remind people of the past and become a memory for the present generation and future generations.

On the other hand, the area of The Museum Fatahillah has been regarded as one of the tourist destinations, for either domestic or international tourists, because this area has been designated as a historical place (*Cagar Budaya*) by UNESCO (see **Fig. 2**). As mentioned by Sauer and Bobkova (2018) that trips to cities represent quite significant part of the global tourism, and urban tourism is considered by United Nations World Tourism Organization (UNWTO) to be an important segment of the international tourism, and as such, it plays a significant role in economic as well as in social environment of many urban destinations. According to Jakarta Tourism Office (2010), the Museum Fatahillah is one of the most significant museums within area Jakarta Old Town. This condition has made the area of The Museum Fatahillah one of the most significant areas within The Jakarta Old Town District, and become the busiest place within the region.

Certain aspects should be fulfilled to reach the criteria's requirement criteria for historic buildings according to UNESCO. This condition has encouraged the local government (DKI JAKARTA Government, 2008) which collaborated with the local Unit Pengelolaan Kawasan to enhance the facilities and services for tourism particularly the infrastructure of the area. Physically, the building of the Museum Fatahillah has the same typology as some government buildings (city hall) in Holland. This existence of The Museum Fatahillah, for sure, will provide a significant atmosphere of colonial architecture as the building in Holland.

The local community, which has the direct impact of the existence of the Museum Fatahillah, will gain some positive effects from the area as a tourist destination. The effects will include some economic, social, cultural and political aspects. All these aspects will be related one to another.

Visitors to The Museum Fatahillah are not just tourists, but also people from educational institutions such as from elementary schools, secondary schools, junior or senior high schools, or even researchers either local or international, who are interested in gaining more information about the history of The Musem Fatahillah. This condition could enhance the emotional bonding for present or future generations concerning the historic building. For example, the current generation, who never knew the building, will have more experiences after their exploration of The Museum Fatahillah. They will feel the sense of the place and will have some attachment to the building.

This condition could be said to be a historical attachment. The future generation will attach emotionally because of the history of the building. The existence of The Museum Fatahillah that had been used as a government office (city hall) and has an underground prison will give more knowledge to the present generation about how the building was before. The current generation will feel the sense of the building and they would attach the information into their mind and would tell to their generation and on to the future generation, and so on.

Furthermore, the historical attachment would give emotional impact to each person, differently, because the existence of historical buildings will provide different experiences to individuals. For example, when someone has explored The Museum Fatahillah, this person would feel the emotional meaning about the building, maybe this person would feel how it was for all Indonesian people who have lived in the underground prison, whether the Dutch people were working on the upper level of the building of Stadhuis. This emotional attachment also cannot be separated with the culture of the community as well, because both aspects are related to each other, as Herliana (2017) mentioned in her research about cultural attachment.

This emotional attachment could be gained by the existence of the old historical building which has been left from the colonial era, that would make people particularly the local community, think not just about the present day but also about the future. A place becomes essential and significant, if there is an emotional attachment between both the community and the place itself, as Dewiyani (2017) mentioned in previous research. People would understand, that there will not be a future without the existence of the history of the past. This condition could not be separated from the conservation and preservation initiative that should be delivered by the government, either locally or centrally to fulfill the needs of the present and the future generations.

3. METHODOLOGY

This research is quantitative research in collecting data and has conducted descriptive qualitative research with a narrative, descriptive approach to describe and analyze the case study in both physical and non-physical aspects. Since the research is historical research, we have studied the historiography and archives that related to the history of Jakarta Old Town District particularly Fatahillah Museum and the surrounded area. We have conducted data collection by spreading 50 questionnaires using google form to identify the level of historical attachment of colonial building through community perception.

4. RESULTS AND DISCUSSIONS

In this research, the data obtained from the sample population which has been conducted from 50 questionnaires from the local community of Jakarta. All the respondents

are various from the age, the occupation, and the educational background. The data have been analyzed by using the statistical method and then interpreted using the knowledge about architectural conservation and historical attachment.

The questions in the questionnaire are gradual which are starting from demographic recognition to the understanding about architectural heritage, architectural conservation and the need for historical attachment to the colonial building. From that data, we have finally concluded and answer the question of this research.

4.1. Demographic Data

Demographic data is one of the significant data in this research because, with this data, we can find the various age of the respondents and the gender of the respondents. The knowledge and understanding of architectural heritage as well as architectural conservation is diverse depends on that demographic data. The age of respondents will show the level of education or knowledge of respondents as well as the level of wiseness. The gender of respondents will indicate the level of awareness of this historical attachment matter as well as the level of wiseness.

In this research, we have divided the age range into five classifications below 17 years old, 17-25 years old, 25-40 years old, 40-55 years old and above 55 years old. **Fig. 3** shows the variation of the respondent's age. Mostly the respondents are between 17-25 years old, and **Fig. 3** shows that this range of ages is about 58,5 %, and has been followed by fourth category 45-55 years old respondent for about 34,1 %. Usually, they are visiting Fatahillah Museum or Fatahillah Square at the weekend. We have seen the area of Fatahillah Square in the weekend, and there are so many teenagers visiting the area of Museum Fatahillah and Fatahillah Square. This place has been regarded as an interesting area with many colonial buildings to be explored, and for teenagers this place is instagrammable.

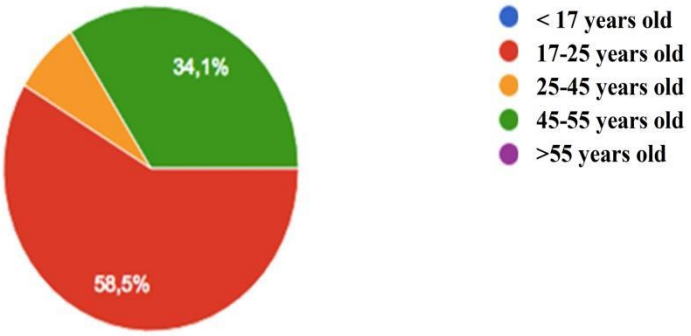

Fig. 3. The variation of respondents by age.

One of preference in choosing a location for a weekend getaway is gender. We have seen directly in the area of Fatahillah Museum and Fatahillah Square, that the visitors of this place have been dominated by the female. And the respondents of this questionnaire mostly are female. From 50 respondents, there are about from 56.5 % female and 43.5 % male. **Fig. 4** shows the data of all respondents either male or female.

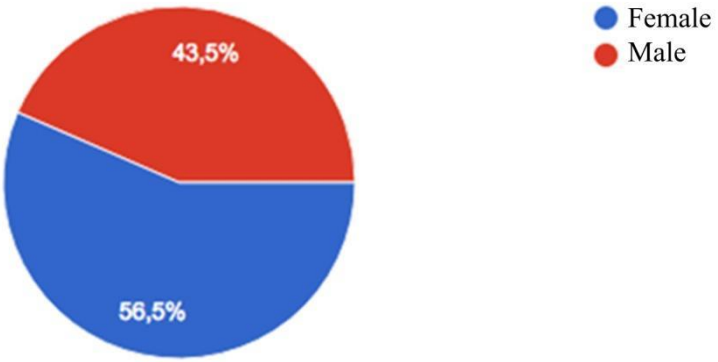

Fig. 4. The variation of respondents by gender.

4.1. Community Knowledge and Attachment of Fatahillah Museum

The level of knowledge will show how to extend to which the community eager to learn about the history of the colonial building, particularly in this research is a Fatahillah Museum. The level of knowledge also related to the level of attachment. The higher level of knowledge will indicate as well that the person also has a higher level of attachment of something, in this case, is a colonial building. We have using some data in the questionnaire to identify the level of knowledge as well as the level of attachment of the community to colonial building within Jakarta Old Town, in this case, is Fatahillah Museum. **Fig. 5** shows that from 50 respondents there is two respondents do not know what Fatahillah Museum is, this condition shows that in the community of Jakarta there is still some individual who does not know about Fatahillah Museum. But beyond that, there are 48 of the respondents about 97.9 % have very well knowledge about the Fatahillah Museum.

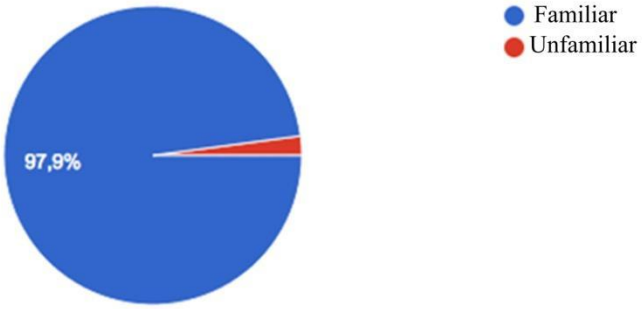

Fig. 5. The knowledge awareness about Fatahillah Museum.

To support the above data, we have asked about whether the community does know or does not that Fatahillah Museum is one of Cultural Heritage in Indonesia. The answer to the question will show the level of knowledge of the community about the urban heritage particularly Fatahillah Museum as a Cultural Heritage. From 50 respondents, there are 5 respondents who have no knowledge that the Fatahillah Museum is one of Cultural Heritage in Indonesia. It is a bit difficult because the understanding about this matter has

not been distributed and circulated very well among the community particularly the community of Jakarta. **Fig. 6** shows that there are about 89.6 % of the respondents know very well that Fatahillah Museum is one of Cultural Heritage in Indonesia. From the data, it can be concluded that all 45 respondents mostly are students.

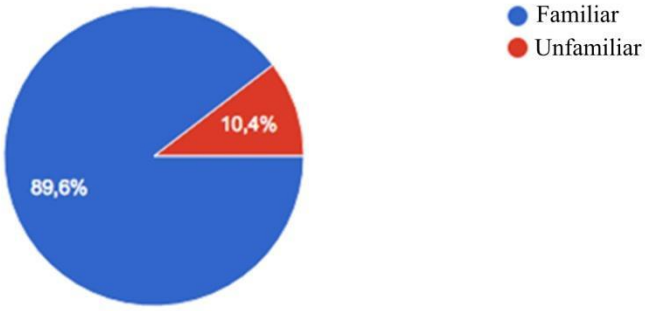

Fig. 6. The knowledge about cultural heritage.

The level of attachment of the community can be seen from how to extend to which respondents will visit the Fatahillah Museum as mention before, that there are some colonial buildings within Jakarta Old Town which have been functioned as a museum. There are Wayang Museum, Bank Indonesia Museum, Bank Mandiri Museum, Museum Bahari or Maritime Museum and Fatahillah Museum. From those four museums, Fatahillah Museum is the most familiar for respondents. From 50 respondents, there are 30 respondents or about 60.4 % choose Fatahillah Museum as their destination (**Fig. 7**).. Second place is the Bank Indonesia Museum about 16.7 % of respondents who select this destination and has been followed by Wayang Museum about 12.5 % of respondents.

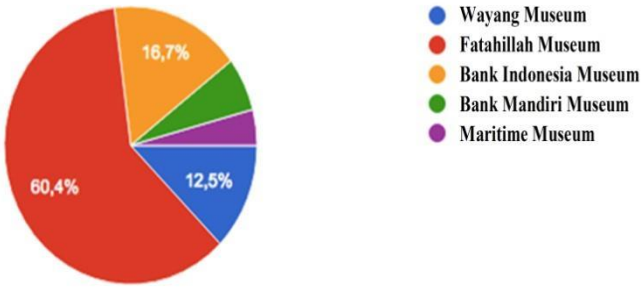

Fig. 7. The destination preference within Jakarta Old Town District.

To support the previous data, we have collected some data from respondents which are related to the preference of the destination. We have divided some category of reason: the historical reason, the building form reason, the atmosphere of the building, and the surrounding environment reason (see **Fig. 8**). From 50 respondents, there are about 51.1 % have stated that they visit the Fatahillah Museum for all reasons from the historical, the atmosphere and the environment as well. Some of the respondents about 17% have stated that the historical reason is the most reason they have visited the Fatahillah Museum.

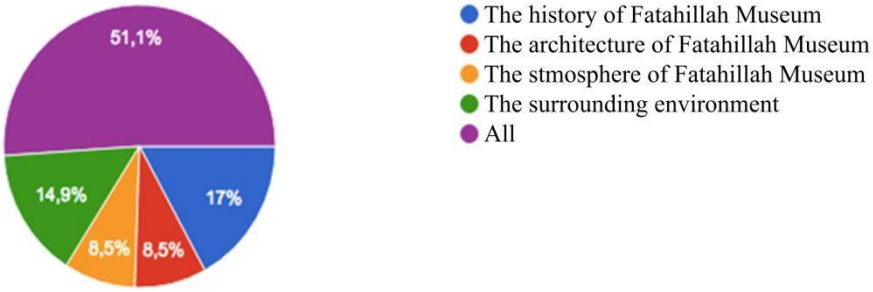

Fig. 8. The reason of visiting Fatahillah Museum.

To conclude this research, we have delivered the final question to all respondents. The question is about how to extend to which the respondents are willing to know and gain more knowledge about the history of Fatahillah Museum. The answer to this final question will support all the above data completely. **Fig. 9** shows that the level of willingness has been divided into 5 levels from the below is level 1, and the higher is indicated by level 5. From 50 respondents, there are about 19 respondents (38 %) in level 4. And there are 32 % or 16 respondents in level 3, and about 15 respondents or 30% in level 5. From those data, it can be concluded that the level of historical attachment of 50 respondents could be stated relatively high. All respondents are still having awareness about Cultural Heritage in Indonesia particularly Fatahillah Museum which is a part of Jakarta Old Town District.

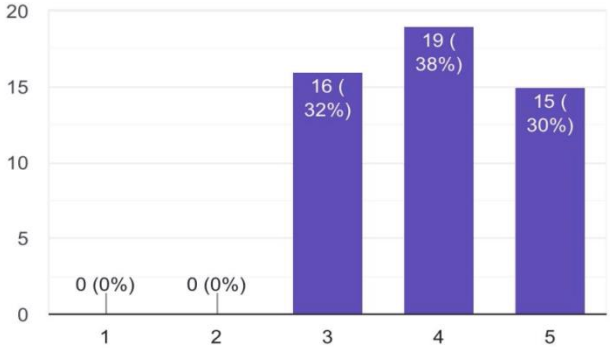

Fig. 9. The level of willingness to gain knowledge about the history of Fatahillah Museum.

5. CONCLUSIONS

The need to conserve and preserve old historical buildings has become a significant agenda for local and central government because the existence of old historical buildings helps each generation to be reminded of all the history of the past. If the local government does not have any willingness to conserve and preserve those old historical building, thus

they will be abandoned. Referring to Tureckova and Nevima (2018), leaving abandoned areas without the effort to find alternative uses for them, regional development is hampered by the fact that it prevents the development of the built-up area, adversely affects the environment and society and has an adverse impact on the entire territorial unit

By presenting the presence of historical old buildings within historical areas and designating historical buildings as conserved buildings, the community will understand and appreciate their existence. This condition will gain and enhance the emotional attachment of people about the presence of historical buildings through their history. Thus the historical attachment of each person could be reached. To obtain historical attachment of historical building in Jakarta Old Town Area particularly Fatahillah Museum, some efforts have been done by the local government:

i) Renovated the Museum and providing a new concept of the Fatahillah Museum
ii) Providing some attraction in the surrounding area of the Fatahillah Museum to attract visitors to come
iii) Using local art and culture to promote the Fatahillah Museum as an icon in Jakarta Old Town
iv) Putting some affiliation to collaborate in promoting the Fatahillah Museum

This research has been completed by analyzing and describing the case study of Fatahillah Museum through community perception. Some results show that community of Jakarta have a strong attachment of the history of Fatahillah Museum; the level of knowledge and attachment also have been identified from the respondents. Furthermore, the research will be developed by exploring the relation between historical attachment and the process of designation of a conservation area and the extent to which historical attachment has a role in the designation of a conservation area.

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This research is based on several years of research which has now been incorporated, from 2016 to 2019, as part of a multi-years research. This research is a first year research project and the publication in the international conference has been self-funded. We would like to thank all students in the Department of Architecture, Universitas Indonesia for helping this research in distributing and circulating all the questionnaires. And finally, we would like to thank to all local community in Jakarta as respondents for this research as primary sources of this research.

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Understanding the Application of Photovoltaic Technology for Public Transportation

Saeful Bahri[1], and Ari Widyati Purwantiasning[2]
[1,]Department of Electrical Engineering, Faculty of Engineering, UniversitasMuhammadiyah Jakarta, Indonesia
[2]Department of Architecture, Faculty of Engineering, UniversitasMuhammadiyah Jakarta, Indonesia

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Abstract

This research is aiming to explore and understand the application of photovoltaic technology particularly in transportation facilities for public users. This research is a first year study which is a part of two-year research. While there are many types of public transportation, this research has a significance type of public transportation which have a particular need for local community within historical area. Furthermore, this research is also aiming in the identification of an appropriate public transportation which suitable to be implemented within historical area. This research has implemented the qualitative method using some theories which have been applied to promote the perfect public transportation to be implemented.

Keywords: *photovoltaic technology, solar cell, public transportation, tram, historical area.*

I. INTRODUCTION

One of a basic concept in Transit Oriented Development is connecting people from one place to another place easily and to do activities within one area to reduce the using of private vehicle. Historical area is one of the most significant area which has a unique character, and usually this area is lack of utilities to support the need of the community. To enhance the quality of this historical area, some initiatives should be done by local government together with all related parties. This research is aiming to propose the idea to provide public transportation within historical area to support the implementation of Transit Oriented Development's concept. This public transportation is not just a transportation within historical area which connecting from one place to another place, but also has a particular technology named photovoltaic technology to be implemented at the public transportation.

One of the idea to implement the photovoltaic technology for public transportation is by using a solar cell. As mentioned by Güneşer, et.al (2015) [1], one of the vehicle that could implement solar cells is a solar electric vehicle (SEV). Solar electrical vehicle is an electric vehicle with onboard photovoltaic cells charging a set of batteries for extended driving range. He also mentioned that solar vehicles can also be designed for transportation on short distance, as between one building to another one within a particular area [1]. We believe by implementing this solar electrical vehicle within historical area, it will become a suitable solution for this area's need.

This research is a part of a research to propose a suitable concept for historical sites in Indonesia, particularly Jakarta as a metropolitan city with Jakarta Old Town Area as the historical site. This research has been done to synergize the concept with a research of Transit Oriented Development to enhance and improve the quality of the built environment as well as the quality of local community significantly. As a part of multi-year research, this paper is aiming to provide some types of public transportation to have an understanding of Photovoltaic Technology for public transportation.

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By understanding the concept of photovoltaic technology for public transportation, it can be concluded and proposed the suitable public transportation to be implemented within historical site of Jakarta. Although this paper is an initial result, it will become the basic thought to do more and to implement it within a case study conducted in Indonesia, generally and Jakarta as a metropolitan city, particularly.

II. WHAT IS PHOTOVOLTAIC TECHNOLOGY

2.1. Basic Theory of Photovoltaci Technology

Bahri, et.al (2018) [2] has explained that energy thermal which has been produced from the sun could be used to produce another energy to fulfill the human need such as energy thermal to make hot water as a heat source in heater machine cycle as moving energy. He has also mentioned that the using of solar energy has another benefit to produce electricity through the using of photovoltaic cell. For the future, the using of solar energy could become an alternative solution for renewable energy. There are many scholars have done and explained that the using of solar energy could minimized the use of electrical energy. Referring to the previous research of Purwantiasning, et al. (2017) [3] in Bahri, et.al (2018) [2], the using of electrical energy from solar energy by implementing the technology of control system for Fatahillah Museum, one of a historical building in Jakarta Old Town, could be maintained and minimized to 30%-60%. This research shows that the using of technology in reducing electricity could become a perfect solution for historical site particularly Jakarta Old Town.

As mentioned in previous research, Bahri, et.al (2018) [2], the word photovoltaic is referring to Greek; photos mean light and volta implies the name of a physician from Italy who found the electricity. In a simple way, photovoltaic could be defined as electricity from light. Photovoltaic also could be defined as a process to convert light energy (sun) become electrical energy. This statement has supported the explanation of some scholars who performed at the Bell Laboratories in the 50's which has been explained by REN21 (2009) in Rizzo (2010) [4]. Rizzo (2010) [4] has explained that the conversion from light into direct current electricity which has been applied for the first time and has been discovered by Alexandre-Edmond Becquerel (1820-1891). Basically, the panels of photovoltaic have working to the semiconductive properties of silicon and other materials, were first used for space applications. He also mentioned that the diffusion of this technology has been growing exponentialy in recent years, due to the pressing need for the renewable and carbon-free energy.

Rizzo (2010) [4] in his research also mentioned that most of the today PV panels, with multicrystalline silicon technology, have efficiencies between 11% to 18%, while the use of mono-crystalline silicon allows to increase the conversion efficienct of about 4 %. It could be concluded that the cost of these latter solutions is still too high for a mass application on private vehicle.

Furthermore, the book of Basic Photovoltaic Principles and Methods (1982)[5], support the statement that the physical phenomenon responsible for converting light to electricity-the photovoltaic effect was first observed in 1839 by a French physicist, Edmund Becquerel. He mentioned that a voltage appeared when one of two identical electrodes in a weak conducting solution was illuminated. The PV effect was first studied in solids, such as selenium, in the 1870s. In the 1880s, selenium photovoltaic cells were built that exhibited 1%-2% efficiency in converting light to electricity. Selenium converts light in the visible part of the sun's spectrum; for this reason, it was quickly adopted by the then-emerging field of photography for photometric (light-measuring) devices. Even today, light-sensitive cells on cameras for adjusting shutter speed to match illumination are made of selenium [5].

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It has been stated as well in the book, that today, photovoltaic systems are capable of transforming one kilowatt of solar energy falling on one square meter into about a hundred watts' of electricity. One-hundred watts can power most household appliances: a television, a stereo, an electric typewriter, or a lamp. In fact, standard solar cells covering the sun-facing roof space of a typical home can provide about 8500-kilowatt-hours of electricity annually, which is about the average household's yearly electric consumption. By comparison, a modern, 200-ton electric-arc steel furnace, demanding 50,000 kilowatts of electricity, would require about a square kilometer of land for a PV power supply [5].

2.2. An Application of Photovoltaic Technology for Public Transportation

Many researches have been done by scholars to define the effectiveness and the benefit of using photovoltaic technology such as solar panels to reduce the using of electricity. Although there are many researches about it, almost all the studies are focused on the using of solar panels for private vehicle in this case is private car [1][4][6][7]. This research will reveal how important the using of solar panel cells for public transportation. The implementation of the technology is almost the same with the private vehicle or cars, but there is the difference for the need and the amount of the energy. As we know that the public transportation will be provided for local community, thus the need of the space for the vehicle will be bigger than private vehicle or car. This condition of course will affect to the need of the energy for public transportation to be movable from one spot to another spot.

As mentioned by Izco (2010) [7], that the using of private vehicle will affect to the producing of global warming because these private vehicles will produce emissions of CO_2. Actually, the producing of CO_2 not just from private vehicles but also from public transportation such as bus, tram, minibus, train etc. Izco (2010) [7] also stated that to solve the problem, there are some important alternative energies that could be delivered. They are solar energy, wind energy, wave energy, blue energy, water power, tidal energy, geothermal energy, and biomass energy. But in this research, referring to the need of reducing the using of electricity, Izco (2010) [7] reduced all those alternative energies into two significant energies: solar thermal and solar photovoltaic energy. Since that solar thermal energy has been used to heat things, the solar photovoltaic energy has been used to generate electricity. Thus, the perfect solution in this case is to deliver and provide the using of photovoltaic energy for vehicle particularly public transportation.

Some studies have mentioned that to apply the using of solar energy to generate electrity, it is needed to understand the basic technique in the application of the energy. Izco (2010) [7] stated there are two types of applications of the solar energy:

1. Network-connected systems
2. Autonomous systems or isolated

As izco (2010) [7] has done his research in implementing the technology of photovoltaic for a car. This research has developed the knowledge to be implemented for public transportation. The energy of the solar will be directly apply to the surface of the vehicle to absorb the solar energy and convert it to the electricity energy (see Figure 1).

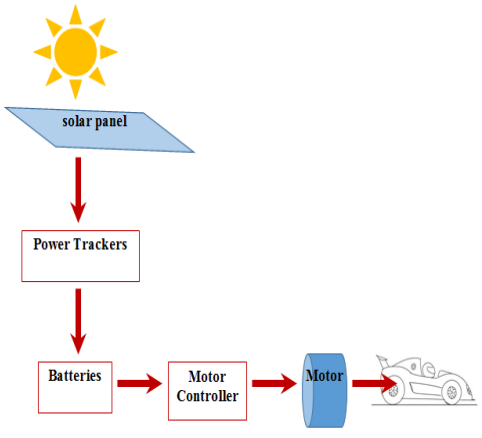

Figure 1: Basic Scheme of Solar Car

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Basically, the scheme of solar car which is shown in Figure 1 is the same with the scheme of solar vehicle for public transportation. The basic concept is to generate electricity through alternative energy of solar energy. The energy from sunlight which go through directly to the solar panels can be converted into other energy forms that could distribute and transfer the electrical energy easily. This process will use some devices known as photovoltaic cells that has a function to convert light energy, photons, into electric current, electrons. This devices of photovoltaic cells are a type of cells that capable to produce an alternative electical energy. This photovoltaic cell can be formed by a sheet of gold or silver, silicon and iron-nickel base.

Taft (2016) [8] has mentioned, although it is very expensive to produce a solar-powered vehicle, but this technology will increase in efficiency and decrease in cost and will support the sustainability of environmentally friendly because this technology will reduce the production of pollution.

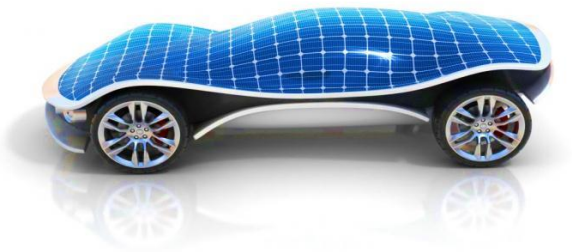

Figure 2: Solar-Powered Car

Source: Izco (2010)

2.3. Types of Public Transportation

Public transport generally could be defined as a transport which have been provided to support the mobility of community in large amount of people. Public transportation usually has delivered a system that could cover urban need, suburban need and also regional need from one city to another. This paper has discussed public transportation within a metropolitan city which will deliver and cover urban need as well as suburban need.

Public transportation has been regarded as the most effective and efficient transportation system in metropolitan city to bring people from one place to another without using any private cars. This is will support the need of the city as a smart and sustainable city. One of the problem in the using of public transportation is the safe and the comfort of the facilties. Usually public transportation is not as comfort as a private vehicle, and this is become an issue that supposed to be handled by the local government. The local community should be encouraged to use public transportation to support the sustainability of the city.

Public transportation in metropolitan city usually have many types. The most familiar public transportation in all cities in the world is public bus and public train. Public train could be tram (light train) or metro which is known as Mass Rapid Transit or MRT in most cities in the world. To define the types of public transportation, we have tried to classify the types as follow:

1. Bus

This type of public transportation is the most familiar among local community either in the urban area or in suburban area. This public transportation is the easiest vehicle that could be reached in all areas or spots. The bus networks usually also the easiest and accessible for people.

2. Tram

This particular public transportation is the significant vehicle that usually has been provided in metropolitan city which is accessible to get from one place to another with large numbers of passengers but not as crowded as train. Usually tram has been provided to support an area with a significant need such as historical area, specific area with specific character. Using this public transportation is also doing travelling for leisure.

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3. Metro/ Mass Rapid Transit

Almost all metropolitan cities in the world have this kind of public transportation. This transportation is very suitable with the city which has high density of population. The metro could accommodate large number of passengers and has been regarded as the most effective and efficient transportation system, because the transportation system and network usually is separated with the transportation system which using usual road, thus it avoids the traffic.

4. Light Rail/ Commuter Line

This public transportation system is almost the same with Metro or MRT, but usually this light rail is only to provide not just for urban network but also suburban network. Usually this transportation system is become a feeder for Metro or MRT to continue to the network in urban area.

5. Train

Usually this kind of public transportation has been used to accommodate people to travel from one city to another. The number of passenger using this public transportation is relatively growing. To support this transportation system, local government also has provided an integrated transportation system between train, commuter line, metro/ MRT, tram and bus. Usually this integrated system is provided in the form of integrated terminal for public transportation. This integrated system will allow passengers to change the public transportation in one place as their need.

2.4. Suitable Public Transportation for Historical Sites

Historical site is an area with a specific and significant character which is usually located in the center of metropolitan city. Referring to the previous research of Purwantiasning (2018) [9], the main problem within historical area is the lack of utilities which is one of the utilities is infratsructure. To handle this issue, there is an alternative solution that could be proposed to increase and enhance the quality of the built environment as well as to enhance the quality of llfe the local community within the area. The quality of historical site also depends on the quality of historical buildings within the area. As Purwantiasning (2013) [10] stated that historical site and historical buildings within it are shaping the identity of a particular city.

Furthermore, to identify what is historical site, we need to define what the conservation is. Purwantiasning (2018) [9] has defined that conservation is a concept that aims to manage a place or historical area, as well as historical objects such as buildings or monuments by applying a particular treatment, and to preserve the values of such historical objects which also should then become a part of the identity of the city. Historical area which has to be designated as a conservation area should has a significant character which has special value either tangible or intangible. The initiative of the local government to designate the historical site to be a conservation area is aimed to strengthen the image of the area as well as to influence the quality of surrounding area which is regarded very meaningful to improve the quality and the image of the environment. According to previous research of Purwantiasning (2018) [9], the designation of conservation area is not olny related to the requirement of the local regulations, but is also connected to the needs of the local community. The activity of conservation in improving and enhancing the quality of environment should describe how the places, particularly historical sites, could be experienced by local people who live and work there as well as by visitors, who will have a direct impact on the area. The impact should be related to the contribution to the area, particularly to its setting and appearance and the quality of life of the local community.

As mentioned in the previous chapter about the types of public transportation, there is a possibility to apply the suitable public transportation within historical site. To choose the suitable public transportation, we have related to the need of historical site particularly the requirement of local

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regulations. The public transportation which has been conducted should not decrease the quality of the environment within historical site as well as not to make visitors and local community uncomfortable. We have identified some criteria that should be analyzed in the applying the suitable public transportation within historical site, as follow:

1. the vehicle will not destroy the environment particularly the historical site
2. the vehicle will not decrease the character of the historical site
3. the vehicle will make the local community and visitors safe and comfort
4. the vehicle will connect one place to another place easily
5. the vehicle will not disturb the existing activity within historical site
6. the vehicle will transit people effectively and efficiently
7. the vehicle will enhance the quality of the historical site

According to the above criterias, we have conducted tram as a suitable public transportation within historical site. We have conducted tram, because there is a minimum construction which will be applied within historical site, thus there will be minimized the damage within historical site. Using photovoltaic technology which will be applied on the tram's surface or roof will also become the most possible. The tram has also been regarded as a relative small public vehicle that possible to be applied within historical site without making large development. The unique design of the tram also would become an excellent new object with a specific character within historical site.

Referring to Vajihi (2017) [11], there is the first train in the world that has adopted and implemented solar photovoltaic (PV) panels to generate the train in 2012. The name of the train is UNESCO Heritage Himalayan Queen Train from Kalka to Shimla in Northern India. The number of the coaches are seven and there are 200 W PV modules were installed on the roof of each coach. The generated energy is store in 2x65 AH Sealed Maintenance Free Tubular 24 V baterries. Each coach has been installed with a 100-watt solar panel with which the coaches can be generated for two days without the sun and can completed two trips to Shima (for about 85 km per trip/ 3 hours). We have adopted this reference to propose the tram within historical site of Jakarta Old Town Area. Since that the area is not too large, we have decided to conducted one-unit tram to be operated within the historical area per trip. This idea has been formed to justify the seven criteria we have mentioned above.

III. RESEARCH METHOD

This research has implemented the qualitative method with literature study as a main method for gathering information. We have conducted some literatures to get the understanding for the photovoltaic technology as a main topic in this research. This research is a part of two-year research which is undertaken to promote an alternative and an appropriate solution for public transportation within historical site in Indonesia, particularly Jakarta as a metropolitan city. From this initial study, we have concluded the suitable public transportation which will be implemented within historical site in Jakarta. To decide the appropriate and suitable public transportation, we have studied the character of the historical area in Jakarta, particularly Jakarta Old Town Area, and we have underlined the character of the local community as well who will use the facility within the area.

IV. DISCUSSION OF CASE STUDY

1.1. Jakarta Old Town Historical Site

According to the Guidelines of Jakarta Old Town (2007) [12], the historical site of Jakarta Old Town has been divided into five zones. They are Zone 1-Sunda Kelapa, Zone 2-Fatahilah, Zone 3-Pecinan or China Town, Zone 4-Pekojan or Kampung Arab, and last one is Zone 5-Kawasan Peremajaan or Rejuvenation Area. The area of Jakarta Old Town

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has a core zone which consists Zone 1-Sunda Kelapa, Zone 2-Fatahillah, Zone 3-Pecinan and a small part of Zone 4-Pekojan. Although there is a core zone or buffering zone, all the zones within Jakarta Old Town are a designated area to be conserved and preserved regardless.

As Purwantiasning, et.al (2015) [13] mentioned in her research before, the experience of revitalization in Jakarta is related to conservation of important buildings. Those buildings within Jakarta Old Town have been designated as listed old buildings within Jakarta Old Town Area, and some of them are in a relatively poor condition, physically these buildings need to be revitalized. The local government of Jakarta has been encouraged to enhance the quality of the Jakarta Old Town Area by making it a comfortable place for tourism. One solution has been to create a pedestrian area within the area. The most familiar place to be visited is Fatahillah Square, the area with plaza and pedestrian within surrounding area. Furthermore, there are now pedestrian routes from this plaza to other interesting places within Jakarta Old Town. Visitors can now reach all the attractive places within Jakarta Old Town on foot from one place to others. Although, the possibility to travel on foot could become a lack opportunity for elderly and children, because the area of Jakarta Old Town is relative large from Zone 1- SundaKelapa to Zone 2-Fatahillah and other zones. This condition has encouraged us to do this research and to propose an alternative solution for better quality within Jakarta Old Town.

Since that one of the issue within this area is lack of infratsructure and facilties, thus will make visitors uncomfortable, we have done this research and proposed a concept of Transit Oriented Development to be implemented within Jakarta Old Town Area. And to support this proposed concept, we have proposed an alternative public transportation within the area which known as tram to support the activities of tourism within the area without interfere and destroy the character of the area as a historical site. This tram is not just a usual public vehicle but it will implement the photovoltaic technology to support the sustainable envrionment by using an alternative solar energy as a main energy to generate the tram.

Source: Guidelines of Jakarta Old Town (2007)

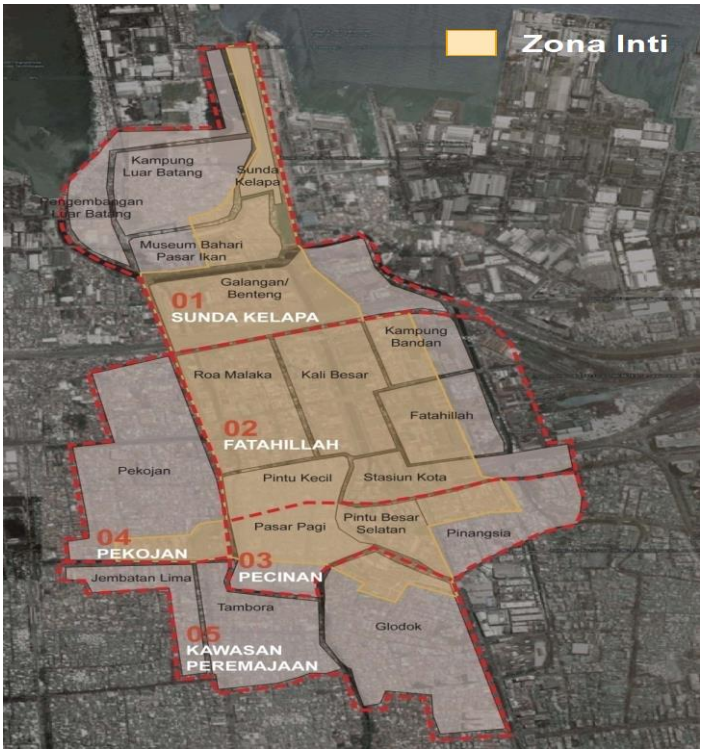

Figure 3: Jakarta Old Town

1.2. The Existing Public Transportation System Surrounding Area

To propose new public transportation system within historical site particularly Jakarta Old Town Area, we have identified the existing public transportation system within surrounding area of Jakarta Old Town. This existing public transportation system will show either the network will support the proposed concept of Transit Oriented Development or not. We have analysed also whether this existing public transportation system have supported the activities within Jakarta Old Town or not. By seeing the existing public transportation system within the Jakarta Old Town Area (see Figure 4), we have proposed some point to be a tram stop within the historical area of Jakarta Old Town. Also, we have

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analysed the radius of walkable area from one spot to other spots within the area.

Figure 4: Existing Public Transportation

Figure 4 shows that there is only one accessible train station nearby the historical site of Jakarta Old Town. This train station known as Jakarta Kota Train Station also provides the network of Commuter Line within Jakarta City as well as the Trans Jakarta Bus Rapid Transit System. The BRT stop is available nearby the train station. Some public transportation that also available nearby the train station are small public vehicles namely "angkot", "bajaj", "bemo" as well as public online service motorcycle called "Gojek" or "Grab".

Figure 4 also shows the network of Trans Jakarta Bus Rapid Transit which has been provided to serve the area of Jakarta Old Town, but the bus stops are relatively far from one historical spot to others. This condition has encouraged us to propose a new concept of public transportation system which cover the area of Jakarta Old Town without interfere and destroy the character of the historical site.

1.3. The Point of Interest within Jakarta Old Town

As mention before, there are many historical buildings within Jakarta Old Town Area which could be explored by visitors. Some of historical buildings have been revitalized to be a new function by implementing an adaptive reused concept. Those historical buildings could be seen in the Figure 5 as follow:

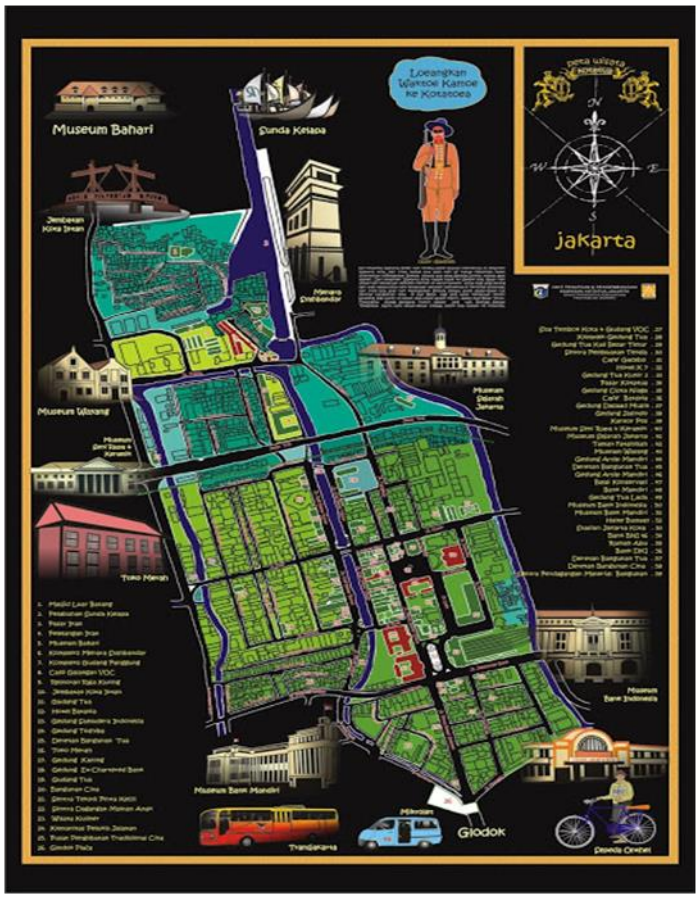

Figure 5: Some historical buildings and point of interest within Jakarta Old Town Area

Source: Guidelines of Jakarta Old Town (2007)

Figure 5 shows there are many points of interest within Jakarta Old Town Area that could be visited and explored by visitors particularly tourists either

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from domestic or international. Those historical buildings and sites are located particularly within Zone 1- SundaKelapa, Zone 2- Fatahillah and Zone 3- Pecinan or China Town. All the location of historical buildings usually can be reached by walking, although it is relatively large area, but visitors have used the pedestrian way to get one building to others on foot.

1.4. The Suitable Point for Tram Station

From the analyzes we have been made, we have proposed some suitable points for tram stop or tram station within historical site of Jakarta Old Town as seen in Figure 6. We have conducted some points using the criteria that we have mentioned in the previous chapter.

Figure 6: A proposed suitable point for tram station

To cover the need of local community as well as the visitors within historical site of Jakarta Old Town Area, we have chosen the closest tram station at Fatahillah Square to serve all the visitors from Jakarta Kota Train Station. The proposed service of tram line is looping within historical site of Jakarta Old Town Area, from Fatahillah Square-Canal Batavia-SundaKelapa (Maritime Museum and Syahbandar Tower) and back to Fatahillah Square. This proposed alternative solution for public transportation within historical site of Jakarta Old Town Area has been conducted to implement and support the concept of Transit Oriented Development within historical site.

1.5. Proposed Design for Tram System within Jakarta Old Town

Referring to some references in previous chapter, the technology of photovolltaic for tram is basically the same with car. The difference is about the amount of the energy that will be consumed and needed to generate the tram. As mentioned by Vajihi (2017) [11], there is a first light rail using photovoltaic technology in India. We have adopted this idea to propose and develop the implementation of photovoltaic technology by using solar energy with panels which will be installed on the roof of the tram. We have proposed one-unit tram in each trip to avoid the crowding of the historical area particularly during the weekend. We have proposed six package of one-unit tram within historical area. We have assumed the trip is about an hour without stoping, and there are 9 stops which need about 10 minutes trip from one stop to another, thus it will need about 90 minutes per trip with 9 stops.

The schematic proposed design for tram system within Jakarta Old Town could be seen in the Figure 7 as follow:

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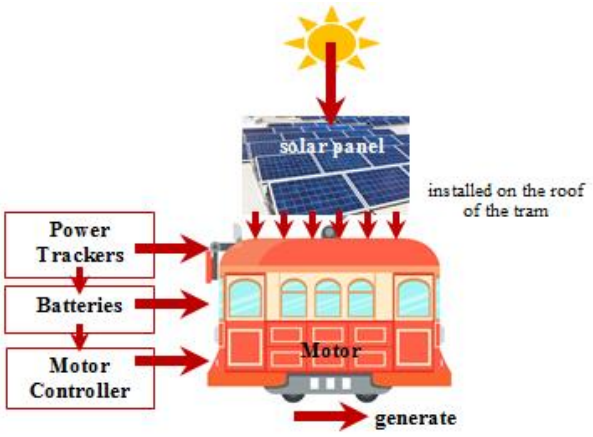

Figure 7: A schematic proposed design for tram system

We have analyzed and calculated some points for the need either the solar panel as well as the need of the unit of the tram to accommodate the passengers in historical site of Jakarta Old Town. There are some criteria that we have to calculate according that, as seen as follow:

1. The specification of the solar panel:
a. Manufacture: C-Sun Solar Panel
b. Dimension: 156 mm (L) x 156 mm (W) x 0,5 mm (T)
c. Rate Power: 5,00 watt
d. Quantity Required: 20 panels/ unit tram
2. The specification of the tram:
a. Power usage of the tram: 100 watts per vehicle
b. Distance in looping trip: 5 km
c. Distance per stops: 1.000 meter
d. Time taken per trip: 60 minutes
e. General power usage per tram per trip one way: 100 watt/ unit tram
f. Frequency from Fatahillah Square to SundaKelapa: 10 minutes
g. Frequency from SundaKelapa to Fatahillah Square: 10 minutes
h. Number of passengers per unit tram: 40 passengers

According to the above specification and the need, we have concluded that this historical area of Jakarta Old Town Area will need approximately about 6-unit tram per day.

V. CONCLUSION

To explore and understand the application of photovoltaic technology particularly in public transportation facilities, we have conducted some theories and studies about it. Starting from the understanding of the application of PV on private vehicle or car, we have underlined that basically the schematic system of the using solar panel cell for car is relatiively similar to the bigger vehicle in this case is public transportation. We have conducted tram as an alternative public transportation within historical site which we have believed that the implementation of this vehicle system will not alter and destroy the character of the Jakarta Old Town Area.

VI. ACKNOWLEDGEMENT

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