Kajian Konsep TOD Pada Kawasan Bersejarah

KLASTER KEILMUAN
PERMUKIMAN DAN PERKOTAAN
Program Studi Arsitektur
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TENTANG
Kajian Konsep TOD Pada Kawasan Bersejarah

Buku ini merupakan salah satu luaran yang dipublikasikan dari hasil penelitian yang diperoleh dari Hibah Kementrian Riset dan Teknologi Direktorat Jenderal Pendidikan Tinggi dengan skim Penelitian Dasar Unggulan Perguruan Tinggi yang dilakukan dengan durasi selama dua tahun. Pada tahun pertama ini, kami berhasil membuat sebuah kajian tentang konsep TOD atau *Transit Oriented Development* yang diterapkan pada kawasan bersejarah. Beberapa studi preseden diberikan sebagai sebuah gambaran bagaimana proses dan juga penerapan dari konsep TOD tersebut.

Dari luaran tahun pertama ini, kami akan melanjutkan penelitian pada tahun kedua dengan memberikan sebuah alternatif solusi yang dapat diterapkan di kawasan bersejarah di Indonesia khususnya di Kawasan Kota Tua Jakarta. Berbekal dengan kajian dari studi preseden yang telah dilakukan di tahun pertama, maka diharapkan penelitian ini akan berlanjut pada skim Penelitian Terapan Unggulan Perguruan Tinggi pada tingkat selanjutnya.

Desiminasi hasil kajian pada tahun pertama ini dilakukan di dalam konferensi tingkat internasional yang telah dilakukan di Amsterdam, dan hasilnya juga dirangkum di dalam buku ini.

Beberapa kajian tentang konsep TOD juga dilakukan sebelumnya, sebagai sebuah kajian awal dari penelitian ini. Publikasi yang telah dilakukan sebelumnya di dalam jurnal tingkat nasional. Dengan melakukan kolaborasi dengan proyek tugas akhir mahasiswa, maka kajian-kajian awal mengenai konsep TOD telah dilakukan dan dijadikan modal awal dari penelitian dasar unggulan perguruan tinggi ini.

Kami juga mencoba menelaah hasil pengamatan dan penelitiannya dalam sebuah tulisan ilmiah yang berkaitan dengan masalah konservasi arsitektur yang dikaitkan dengan konsep TOD dalam kawasan konservasi atau kawasan bersejarah dengan berbagai sudut pandang yang berbeda. Dalam penulisan setiap artikelnya, disesuaikan dengan tulisan asli seperti yang telah diterbitkan pada jurnal nasional dan jurnal internasional, sehingga penggunaan bahasanya masih menggunakan dua bahasa yaitu baik bahasa Indonesia maupun bahasa Inggris.

Kami berharap bahwa dengan diterbitkannya buku Kajian Konsep TOD Pada Kawasan Bersejarah ini, maka wacana dalam bidang arsitektur juga diharapkan dapat meluas sehingga dapat memungkinkan adanya kajian lainnya yang lebih dalam ataupun dari sudut pandang lain baik dari kelimuan arsitektur ataupun keilmuan lainnya yang saling terkait. Sebagai penutup, kami berharap buku ini dapat bermanfaat bagi semua pihak terutama bagi para akademisi.

Ari Widyati Purwantiasning
Jakarta, November 2019

Ucapan Terima Kasih

Buku Kajian ini merupakan salah satu hasil luaran dari penelitian multi tahun yang dimulai sejak awal tahun 2019 sebagai Tahun Pertama Penelitian dan diakhiri pada tahun 2020 sebagai Tahun Kedua Penelitian. Buku ini merupakan salah satu luaran dari Penelitian Hibah KEMENRISTEK DIKTI dengan Penelitian Dasar Unggulan Perguruan Tinggi. Penelitian Hibah didanai oleh Kopertis Wilayah III Jakarta, Kementrian Riset, Teknologi dan Pendidikan Tinggi, Direktorat Jenderal Penguatan Riset dan Pengembangan, Indonesia, dengan Nomor Kontrak 07/E/KPT/2019, tertanggal 19 Pebruari 2019.

Daftar Isi

#01

Understanding the Concept of Transit Oriented Development Through Proposed Project of Manggarai, Jakarta Selatan, Indonesia

Ari Widyati Purwantiasning

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Abstract

TOD's concept which stands for Transit Oriented Development is one of an alternative solution to tackle traffic issues within metropolitan cities generally and Jakarta particularly. By adopting the concept of TOD, many buildings with a different function could be integrated to provide an easy, safe and comfort life for users. TOD's concept usually has integrated transportation facilities such as rail station, bus terminal, commuter line terminal with other facilities such as residential and commercial's function. All those facilities will be designed integrated to create better access for the community to get an easy way from one facility to another one. This concept will linkage residential area with office area and commercial area, thus people who live within the residential area could reach their working place easily by walking using the facility of pedestrian way. This paper has discussed about how the concept of TOD will become one of an alternative solution to create a better accessible environment within Jakarta.

Keywords: TOD, Manggarai, linkage, accessible environment

Introduction

One of the most crucial thing in urban issue is a traffic jam within metropolitan cities in Indonesia generally, and Jakarta as capital city particularly. This issue always becomes a burden for the city, and never be handled correctly by the local government as well as central government. The problem of traffic jam has been handled with many programs, but it will be not solved maximally if the

behavior of the community will not support the government's effort. One of the government programs to tackle this issue is by delivering some transportation system within the city such as upgrading the public transportation system of Commuter Line and Trans Jakarta as a popular public transportation in Jakarta.

The concerning about the above issue has not been aware by the community because the using of public transportation is not optimally use. Some part of the community still using a private vehicle to mobile from one place to another, this condition will support the status of traffic in Jakarta as a capital city. In the end, this condition indirectly will not help the government to solve the urban issue.

According to the above condition, the central government has started to think and keen in searching an alternative solution to handle one of this urban issue. One of the concepts that could be

adopted and adapted from another country is by delivering and implementing the new concept of TOD which stands for Transit Oriented Development. This concept of TOD has been regarded as a perfect solution to handle an urban issue such as traffic jam, particularly in the metropolitan city. Many developed countries that have adopted this concept of TOD, such as Malaysia, Singapore, and Hong Kong. Especially Singapore which is very succeeded in encouraging their people to use public transportation, which could reduce the use of a private vehicle.

Basically, the concept of TOD is a concept to integrate three main functions in the community's life, how to integrate the activity and function of working, living and recreation in one area. At least by integrating that three functions and activities, it could reduce the main problem of the urban issue. By implementing the concept of TOD in the urban area, the community will not use a private vehicle to go to work from their residence. The alternative is by working nearby to their place, and they could use the pedestrian way for walking, biking or use public transportation from the terminal nearby to their place. The one that should be underlined in this concept is all the public transportation should be feasible and decent to be used by the community. Thus they could feel comfortable and safe while using this facility.

It could be underlined that TOD is concept "To create an integrated area with a specific character which provide accessibility for pedestrian and transit for public transportation to

enhance the quality of environment to be comfort, safe, attractive and sustain".

This paper will explore the proposed project of TOD in Manggarai District. By studying this proposed project and using the standard of TOD concept, hopefully, this paper could explain how is the TOD concept could be delivered in a metropolitan city. And in the end, this paper could support all the people to understand the basic concept of TOD.

Material and Methods

Basic Concept of TOD

According to Institute for Transportation and Development Policy, TOD or Transit Oriented Development could be defined as "an integrated urban place designed to bring people, activities, buildings and public space together, which easy walking and cycling connection between them and near excellent transit service to the rest of the city…" [1]

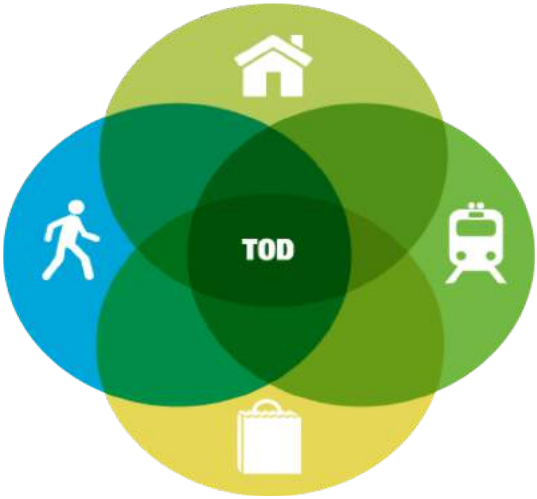

Figure 1: how the TOD's concept integrated three function in an area
Source: TOD Standard Book, 2017

From the above definition, it could be explained that a district or an area which implemented a concept of TOD is an area or a district that could be said as an area or a district which could accommodate the community in doing many activities within it. In another word, this area or district should have a variety zones, not only for residential but also for commercial, public use, and green area. An area or a district which implement Transit Oriented Development concept could be developed by thinking of the need of pedestrians and bikers. It means that mostly the circulation way within an area of TOD from the dimension, size and numbers will be more to accommodate pedestrians and bikers compare to

vehicles. From the above meaning, it could be said that an area or a district with TOD concept should be designed and planned to be near to the public transportation system that could be accessed by walking distance, and this public transportation could deliver the people to the city center comfort and safety.

Basic Principle t of TOD

According to TOD Standard Book from Institute for Transportation and Development Policy, it has been explained that there are some basic principles of Transit Oriented Development concept. These basic principles could be used to design, plan and to develop an area or a district to implement a concept of Transit Oriented Development. These basic principles could be explained as follow:

1. **Walk**
   Developing an area or a district which promote walking as a principle is one of a basic principle in a concept of Transit Oriented Development. Walking has been regarded as a natural activity which is a healthy, a clean, an efficient, an affordable and an effective way to get from one place to another which is accessible for all people. And walking is one basic component that will be needed in almost all traveling which using the transit system.

2. **Cycle**

   An area with Transit Oriented Development concept should have a priority for pedestrian and bikers. According to TOD Standard, it has been mentioned that cycling is the second number that has been regarded as a healthy, an affordable and inclusive mode of mobility within an urban area.

3. **Connect**

   Developing an area which has a crowded network for transportation with road, street and way, will encourage the urban planner to design and plan the area of TOD with smaller blocks of residential and other buildings. This will produce a good design with compact network and well connected between one function to another one.

4. **Transit**

   The location of an area of TOD should be near to the mass or public transportation facility which has good quality. Accessible mass transportation facility for pedestrian will encourage people to walk and use the pedestrian way, and people will no longer use a private vehicle to go to work. Reliable mass transportation facility which is scheduled and fast will make user comfort and safety. This transportation system could be BRT: Bus Rapid Transit, or MRT: Mass Rapid Transit. Both are part of Transit

Oriented Development's concept and become a requirement for TOD's standard.

5. **Mix**

   Planning an area with variety function, use, need, economic level, and demography should be designed with many considering from all aspects with physically or non-physically. The different use and need of all level of the community should be considered, because it will affect the comfort and safe of the area.

6. **Density**

   To maximize the density of the area and justify the capacity of mass transportation is one of the standard of TOD's concept. The development model of high density is an important thing to support the vision of a friendly city and smart city using TOD's concept. Particularly with good and organized mass rapid transportation system with a good schedule, fast, well connected and reliable to guarantee the independence of private vehicles.

7. **Compact**

   Creating an area with accessible distance from residence to mass rapid transportation facility is one of the TOD's concept. Basic guidance principle of TOD's concept is compactness. An area of TOD should have all the components and facilities which area needed by the

community and accessible to get. All the services should be easy to get, comfort, safe, efficient distance and reliable.

8. Shift

Enhancing the mobility of people within an area of TOD is one of the concepts of TOD. Parking area and street use should be well organized to minimalize the use of private vehicles. This condition will support the concept of TOD to be succeeded.

Figure 2: the relation between stakeholders in TOD's Concept
Source: TOD Standard Book, 2017

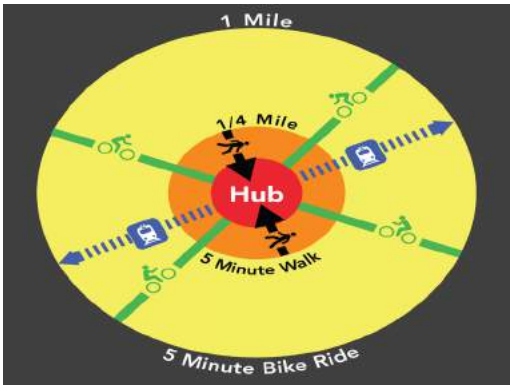

Figure 3: the basic concept of TOD
Source: TOD Standard Book, 2017

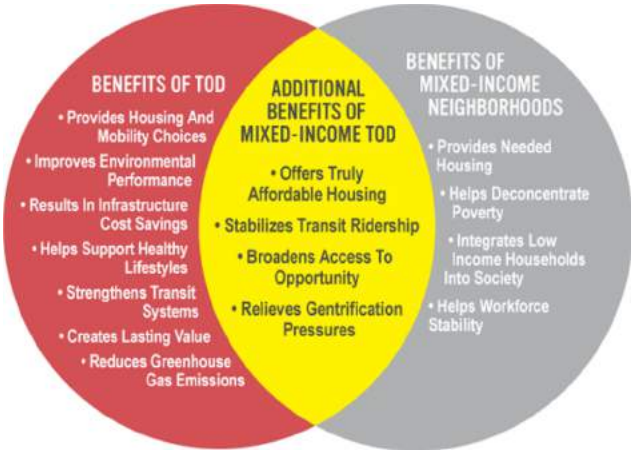

Figure 4: the benefits of concept TOD
Source: TOD Standard Book, 2017

Method

This study has conducted a descriptive narrative method, which studies a proposed project of Manggarai. This area of Manggarai has been designated to be planned and designed for Transit Oriented Development. This paper has described and analyzed one by one of the 8 basic principle of TOD that has been explained before, using the proposed project of Manggarai.

Discussions

Manggarai as a primary district for economic activities in Central Jakarta has been promoted to adopt TOD concept. There are some issues in the district of Manggarai, that will become a starter point to implement the concept of TOD. According to Dinas Tata Ruang DKI Jakarta, those main issues could be explained as follow:

- Manggarai will become a central primary activity and an economic strategic area within Jakarta.
- Manggarai has been designated as an area which adopts the concept of TOD and will be oriented to the public transportation system transit and mobility of pedestrian
- Manggarai rail station will become a node of Commuter Line from Bekasi, Depok, and Bogor
- There will be a development of double tracks of Rail and Commuter Line
- The existence of Balai Yasa would be needed as a rail maintenance and service

- There is a crowded settlement area which is potency to become a slum area
- There should be designed a vertical house as a support to implement a concept of Green City
- There should be a lifestyle changing from community when the area has been developed as a TOD area
- There is lack of public open space
- There should be a program to handle the problem of flooding in Kali Ciliwung

From the above main issues, a local government keen to design and plan the area of Manggarai by adopting a concept of Transit Oriented Development. This development aims to enhance and upgrade the quality of Manggarai district as a primary district in Jakarta. The design should cover the urban space planning including architecture, a landscape of the area, urban planning, utility and infrastructure of the area, preservation of the area and transportation within the district of Manggarai.

Figure 5 shows the area of Manggarai as a proposed project of the development using Transit Oriented Development's concept. There is an existing rail station known as Manggarai Rail Station which service all the resident within the district as well as to service all customer from Depok, Bekasi, and Bogor. All the customer from those three main stations will transit at Manggarai Rail Station, and either will continue to another destination using Commuter Line, Trans Jakarta as well as using another public transportation at Manggarai Bus Terminal. The problem is those two public transportation facilities are not connected each other, and people have to walk uncomfortable and unsafely from Manggarai Rail Station to Manggarai Bus Terminal. According to this condition, a local government keen to propose a development project of Manggarai District to implement the TOD's concept within the area.

From the Figure 5, it shows that there is an area which consists some historical buildings. Those buildings are Manggarai Rail Station itself (Grade A), Prasasti Pintu Air Manggara (Grade A), Elementary School SDN 01 Manggarai (Grade A), Junior High School SMPN 03 Manggarai (Grade A), Water Tower Manggarai (Grade B), Balai Yasa (Grade B), Police Warehouse (Grade B), and many houses in North Manggarai (Grade B). This condition will become the main problem in the development of the area because referring to Undang-Undang Cagar Budaya RI No. 11 Tahun 2010, all buildings in Grade A and B should be preserved

and conserved. It means that the development should concern about it.

Figure 5: the area of Manggarai, Jakarta, Indonesia, which show the basic component of TOD, there is a public transportation facilty: Manggarai Rail Station as a main component that should be provide for an area of TOD
Source: Dinas Tata Ruang DKI

Figure 6: the area of Manggarai, Jakarta, Indonesia, which show the basic component of TOD, there is a public transportation facilty: Manggarai Rail Station as a main component that should be provide for an area of TOD
Source: Dinas Tata Ruang DKI

Figure 6 shows how local government will develop the area of Manggarai. Local government has set some concept within the area of Manggarai based on Transit Oriented Development's concept as follow:

- Integrated mobility and transit between public transportation facilities, which will develop a double track rail Manggarai-Cikarang, develop corridor 14 of Trans Jakarta from Manggarai to Universitas Indonesia Depok,

develop the rail station of Manggarai to be double-decker to Soekarno Hatta Airport.

- Providing transit area between public transportation facilities
- Creating environment with pedestrian and bikers' oriented, with providing pedestrian way and bikers' track within area or Manggarai
- Developing mix used building which contains low-middle apartment known as Rumah Susun (Rusun Berlan by Kemenpera, Rusun Pasar Rumput). These Rusun will provide market, public open spaces and residential space. Rusun Pasar Rumput will become a low middle resident which will be provided for community from Ciliwung Bank of River.
- Developing the area become high-intensity area.
- Creating a specific character of the area
- Limiting the vehicles' movement and parking area within Manggarai District
- Creating public open space for the community

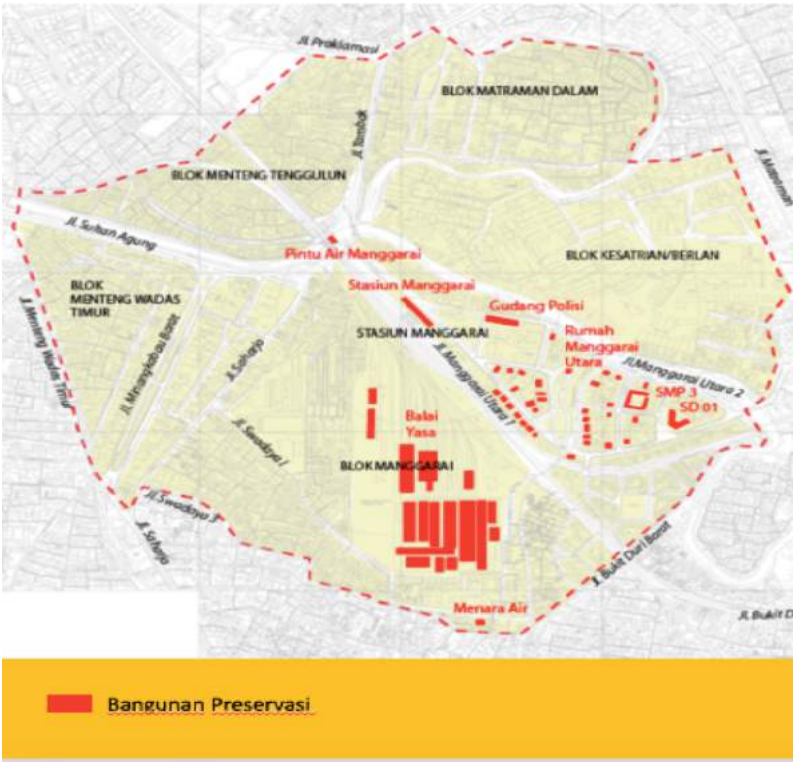

Figure 7: Blocks of historical buildings within Manggari district, that need to be concerned in the development of area Manggarai using Transit Oriented Development concept
Source: Dinas Tata Ruang DKI

Figure 8: Historical buildings within Manggari district, that need to be concerned in the development of area Manggarai using Transit Oriented Development concept
Source: Dinas Tata Ruang DKI

Figure 9: The Existing of Path and Road Network within Manggarai District
Source: Dinas Tata Ruang DKI

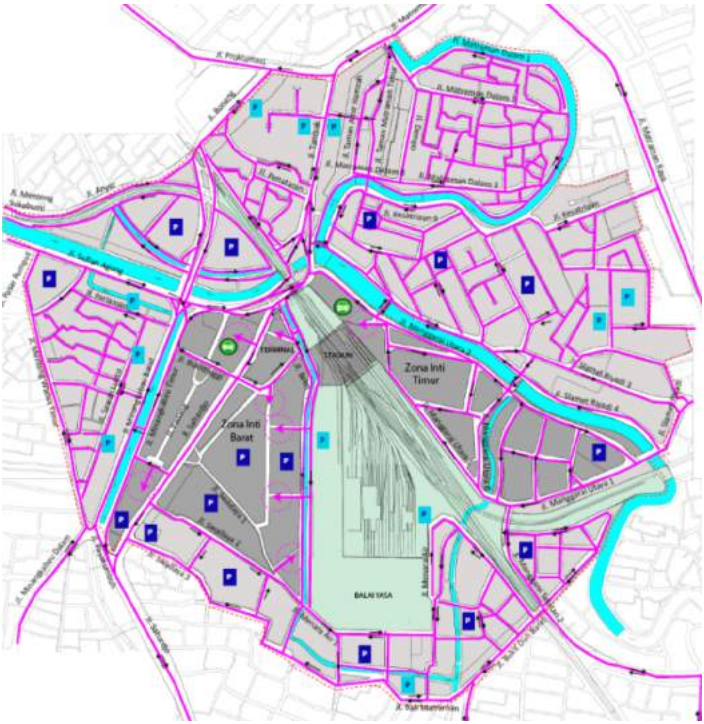

Figure 10: The Existing circulation of vehicles and parking area within Manggarai District
Source: Dinas Tata Ruang DKI

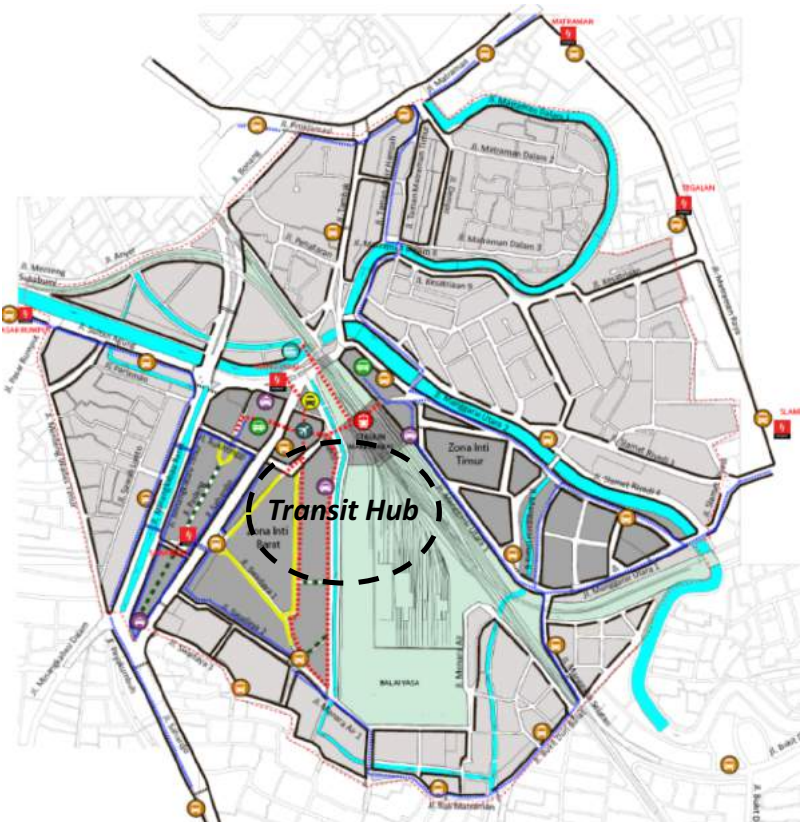

Figure 11: The Existing public transportation services and proposed transit hub area within Manggarai District
Source: Dinas Tata Ruang DKI

Figure 9 and 10 show the existing path, road, and streets, as well as the existing circulation of vehicles either public transportation or private vehicles and parking area within Manggarai District.

Using the figure 9 and 10 could be identified the existing public transportation services within Manggarai District. From figure 11, it could be seen the area of two main public transportation services: Manggarai Rail Station and Manggarai Bus Station. This point will be proposed as a Transit Hub.

Figure 12 shows the possibility of pedestrian ways and bikers' ways within Manggarai District.

The possibility of pedestrian ways and bikers' ways will be used as a basic need in the Transit Oriented Development's concept which will be applied in the Manggarai District. This both facilities for the community will be designed as comfortable as possible to encourage people to walk around in Manggarai District. The circulation of pedestrian ways and bikers' ways should follow the circulation to the proposed Transit Hub from residential or offices. This concept will provide the easy way to get access from place to live to go to place to work.

Figure 12: The possibility of the pedestrian ways and bikers' ways which will be proposed in Manggarai District to apply the concept of Transit Oriented Development
Source: Dinas Tata Ruang DKI

The above explanation has consisted some of the standards of Transit Oriented Development's concept. They are Walk, Cycle, Transit, Connect and Shift. To apply the other standard of Transit

Oriented Development concept, local government have tried to propose a mix used concept within the area of Manggarai.

The standard of Density, Mix, and Compact will be applied to a mix-used building which is in this development will provide Rumah Susun which consist market and public open space under the residential. The high density of the area will be shown from the high level of the low-middle apartment which will be designed about 24 floors. This rumah susun will be provided for the community from Ciliwung River Bank who will be located into this mix used building.

Figure 13: The existing and proposed public open spaces and green belts within Manggarai District
Source: Dinas Tata Ruang DKI

Figure 13 shows the existing and proposed public open spaces and green belts which will support the area to be more comfortable for the community. This condition will encourage people to use pedestrian way for walk and bikers' way for cycling from their place to live to go to their place to work. The successful of Transit

Oriented Development's concept could be described from the public transportation use and all services which following the standard of Transit Oriented Development's concept.

Local government keen to propose this development of Manggarai District to become a pilot project that applies Transit Oriented Development's concept by proposing the masterplan of Transit Oriented Development for Manggarai District. Figure 14 shows how the masses of the buildings within Manggarai District will be planned and design by local government to make the area become a success development area using Transit Oriented Development's concept.

Figure 14: The proposed master plan of Manggarai District using Transit Oriented Development's concept
Source: Dinas Tata Ruang DKI

Conclusion

By implementing a concept of TOD, hopefully, it could create an integrated area with a specific character which provides accessibility for pedestrian and bikers, transit for public transportation as an effort to enhance the quality of the environment to be more comfortable, safe, attractive and sustainable. For the success of the implementation of TOD's concept, it becomes not only a local government or central government responsibility but also all parties such as community as a direct user, private sector as a developer, investor, as well as authority who related to the public transportation policy.

In the end, of the TOD's concept has been succeeded implemented in an area, the community could take the benefit of it. There will be an easy way for mobility without using private vehicles, the environment will be healthier, and this will affect the community directly. The community will live in a healthy environment, and the impact will be sustained for the future because it will become a high investment for the country.

References

[1] ITDP. 2017. TOD Standard 3rd Ed. Institute Transportation and Development Policy. New York.

[2] Undang-Undang Republik Indonesia Nomor 27 Tahun 2007 tentang Penataan Ruang.

[3] Jacobson, Justin, and Ann Forsyth. 2008.

[4] Seven American TODs : Good Practices For Urban Design in Transit Oriented Development Project, Journal of Transport and Land Use.

[5] Steer Davies Gleave. 2009, A Guide to Transit Oriented Development (TOD), Draft Final Report, Sacramento Regional Transit.

[6] Canada Mortgage and Housing Corporation. 2009, Transit Oriented Development Case Studies The Bridges, Calgary.

[7] DKI Jakarta. 2012, Rencana Tata Ruang DKI Jakarta 2030, Perda No. 01 tahun 2012

[8] CUTR. 2002, Building Transit Oriented Development in Established Communities, Technical Report, Center For Urban Transportation Reaserch University Of South Florida

#02

Revitalisasi Kawasan Kota Tua Jakarta Dengan Alternatif Konsep TOD

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ABSTRAK

Kota Tua Jakarta memiliki potensi untuk dikembangkan dengan menggunakan prinsip-prinsip *Transit Oriented Development* (TOD), dimana TOD merupakan pengembangan kawasan dengan menjadikan titik transit sebagai pusatnya.Yang mana titik transit tersebut saling terintegrasi satu dengan yang lainnya dan berkembang di sekitar titik transit tersebut.Tulisan ini bertujuan untuk memberikan alternatif solusi dengan perencanaan revitalisasi kawasan Kota Tua Jakarta dengan menerapkan delapan (8) prinsip TOD yakni berjalan (*walk)*, bersepeda (*cycle*), menghubungkan (*connect*), angkutan umum, (*transit*), pembauran (*mix*), memadatkan (*densify*), merapatkan (*compact*) dan beralih (*shift*).Dengan menerapkan prinsip-prinsip TOD tersebut pada kawasan Kota Tua Jakarta maka diharapkan Kota Tua Jakarta dapat berkembang menjadi lebih baik dan sesuai dengan prinsip-prinsip yang diusung oleh konsep TOD.

Kata Kunci: Kota Tua, Jakarta, Revitalisasi, TOD

ABSTRACT

Jakarta Old Town has a potency to be developed using the principles of Transit Oriented Development (TOD). TOD itself is a development of the region by making the transit point as a center. Which is where the transit points are integrated with each other and develop around the transit point. This study aims to revitalize the Old Town area of Jakarta by applying eight (8) principles of TOD: *walking, cycling, connecting, public transport, transit, mixing, densify, compact* and *switch (shift).* By applying the principles of TOD in the Old Town of Jakarta it is expected that the Old City of Jakarta can be developed to be better and in accordance with the principles that are carried by the concept of TOD.

Keywords: Old Town, Jakarta, Revitalisation, TOD

PENDAHULUAN

Pengembangan kawasan Kota Tua Jakarta dengan konsep TOD menjadi pilihan untuk mengatasi permasalahan-permasalahan yang ada di kawasan tersebut, seperti permasalahan kemacetan, banjir serta dapat mengembangkan potensi wisata Kota Tua Jakarta. Kondisi wisata Kota Tua Jakarta saat ini hanya terpusat di sekitar Museum Fatahillah dan sekitarnya sedangkan cakupan kawasan Kota Tua Jakarta tidak hanya yang berada di sekitar Museum Fatahillah. Luasan Kota tua Jakarta bagian inti sekitar 86 hektar. Dengan luasan yang cukup luas tersebut banyak potensi wisata yang dapat dikembangkan. Sistem transportasi kota Jakarta saat ini mengalami kemajuan yang signifikan dimana saat ini pemerintan provinsi DKI Jakarta sedang mengembangkan transportasi massal lainnya seperti MRT serta LRT. Dengan adanya transportasi massal tersebut sejalan dengan konsep TOD dimana bangunan transit merupakan pusat dari pengembangan kawasan. Stasiun Jakarta Kota merupakan salah satu yang masuk ke dalam rencana pengembangan trasnportasi massal baru yang direncanakan pemerintah provinsi DKI Jakarta.

TUJUAN

Berdasarkan dari pendahuluan, maka dapat dirumuskan tujuan dari penerapan konsep TOD pada kawasan Kota Tua Jakarta ialah sebagai alternatif solusi dalam merevitalisasi kawasan Kota Tua dimana sistem transportasi massal saling terintegrasi satu dengan yang lainnya. Dimana bangunan transit merupakan pusat dari konsep TOD.

METODE

Lingkup studi penelitian ini dibatasi pada prinsip-prinsip pengembangan kawasan dengan konsep TOD yang sesuai dengan disiplin ilmu arsitektur yang baik dan benar. Metode kajian dan penulisan menggunakan metode kualitatif, dengan metode pengumpulan data melalui wawancara, studi literatur, obervasi, dan survei ke lokasi yang akan digunakan sebagai studi kasus.

PEMBAHASAN

Kata konservasi itu sendiri berasal dari kata *conservation* yang terdiri atas kata *con* (*together*) dan *servare (keep/save)* yang memiliki pengertian mengenai upaya memelihara apa yang kita punya (*keep/ save what you have)*, namun secara *bijaksana (wise use)*. Ide ini dikemukakan oleh Theodore Roosevelt (1902) yang merupakan orang Amerika pertama yang mengemukakan tentang konsep konservasi. Konservasi dalam pengertian sekarang, sering diterjemahkan sebagai *the wise use of nature resource* (pemanfaatan sumberdaya alam secara bijaksana). (Purwantiasning et.al, 2012).

Banyak istilah-istilah yang digunakan masyarakat untuk menyampaikan gagasan mengenai TOD, desa transit "*transit villages"*, pembangunan yang mendukung transit *"transit-supportive development,"* desain ramah-transit *"transit-friendly design"* Dan istilah TOD yang paling banyak digunakan dimana istilah TOD mengacu kepada hal apapun yang berorientasi pembangunan transportasi, termasuk bus dan pembangunan rel

kereta api sepanjang jalan raya (Lefaver 1997). Prinsip-prinsip TOD terdiri dari 8 poin yakni, berjalan kaki (*walk)*, bersepeda *(cycle),* menghubungkan *(connect),* angkutan umum *(transit)*, pembaruan *(mix)*, memadatkan *(densify)*, merapatkan *(compact),* beralih *(shift)* (TOD standard, 2017).

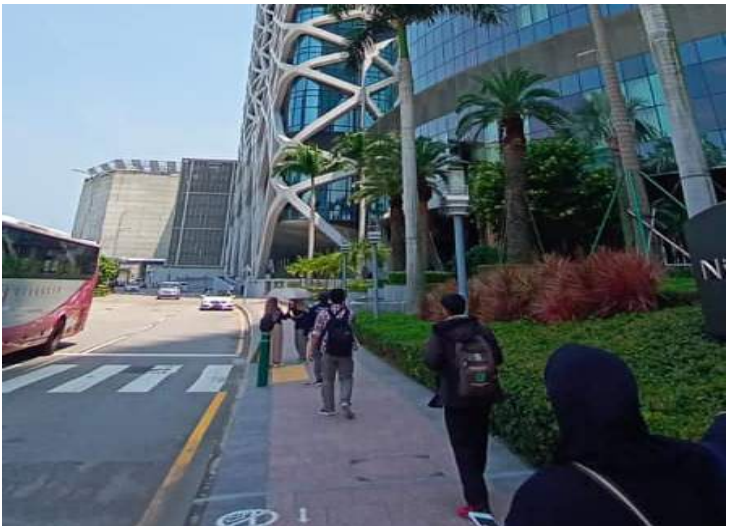
Pada intinya konsep TOD bertujuan bagaimana mengembangkan kawasan dengan sistim transportasi massal yang saling terkait dan terintegrasi, dengan menggunakan prinsip-prinsip TOD dalam menata kawasan khususnya kawasan Kota Tua Jakarta yang statusnya merupakan kawasan konservasi yang dilindungi oleh UU. Menata kawasan dengan konsep TOD dilakukan dengan tetap memperhatikan kaidah-kaidah dalam pengembangan kawasan yang berstatus kawasan konservasi, seperti menggunakan pendekatan *adaptive reuse* dalam mengembangkan kawasan tersebut.

Prinsip- prinsip TOD dapat dilihat pada diagram di bawah ini.

Gambar 1: Diagram prinsip TOD
Sumber: TOD Standard (2017)

Berjalan Kaki *(walk)*

Berjalan kaki dalam prinsip TOD diartikan sebagai kemudah dan kenyamanan pejalan kaki dalam mencapai titik-titik transit di dalam kawasan tersebut.Hal tersebut termasuk sarana dan prasana yang dapat menunjang kegiatan berjalan kaki, seperti tempat penyeberangan serta jalur pedestrian yang cukup untuk dilewati pejalan kaki yang membawa barang bawaan. Seperti yang ditunjukkan oleh Gambar 2.



Gambar 2: Ilustrasi Berjalan Kaki
Sumber: Dokumentasi Pribadi (2019)

Bersepeda *(cycle)*

TOD memberikan prioritas kepada jaringan transportasi tidak bermotor sehingga transportasi seperti sepeda menjadi transportasi yang dapat mendukung program dari TOD tersebut. Dimana hal tersebut didukung akan tersedianya fasilitas yang baik terhadap jaringan jalan di dalam tapak. Dimana transportasi sepeda merupakan kendaraan dengan resiko kecelakaan kecil sehingga sangat mendukung terhadap prinsip- *prinsip dasar TOD.*

Gambar 3: Ilustrasi Bersepeda
Sumber: Dokumentasi Pribadi (2019)

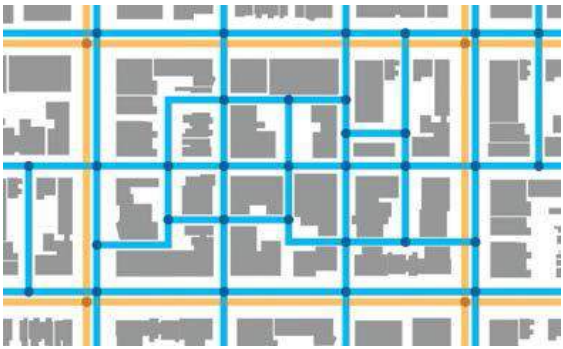
Ketentuan jalur sepeda mengikuti standard yang di terapkan oleh Dirjen Bina Marga seperti terlampir pada Tabel 1.

Tabel 1. Standard Ukuran Jalur Sepeda

Lebar Minimum jalur sepeda	2 meter
Lebar minimum jalur sepeda: - Pada jalan tipe I - Pada jalan tipe II, III	 3,5 meter 2,5 meter
Jika jalur tidak terlalu padat	50 cm
Lebar minimum jalur sepeda	1 meter
Lebar ruang bebas antara jalur sepeda dengan lalulintas	1 meter

Sumber: Dirjen Bina Marga (2017)

Menghubungkan *(connect)*



Gambar 4: Ilustrasi connect, dengan memperlihatkan jaringan jalan yang menghubungkan antara satu fungsi ke fungsi lainnya
Sumber: Hasil analisis (2018)

Inti dari menghubungkan ialah menciptakan jaringan jalan dan jalur pejalan kaki yang dapat menjangkau ruang pejalan kaki yang singkat dimana pejalan kaki mudah untuk mencapai tujuan tanpa

perlu berjalan jauh.Cara yang dapat dipergunakan ialah dengan membuat blok-blok kecil dalam kawasan yang saling terhubung. Dengan adanya blok kecil yang saling terhubung pejalan kaki tidak perlu memutar jauh untuk mencapai suatu tujuan, seperti pada Gambar 4.

Angkutan umum *(Transit)*

Pengembangan kawasan dengan konsep TOD terpusat pada titik area transit dimana bangunan transit menjadi titik pusat pengembangan kawasan. Tujuan dari konsep Tod ini ialah memininalisir penggunaan kendaraan pribadi dan beralih menggunakan transportasi massal. Pada kawasan Kota Tua Jakarta titik transit utama berada pada stasiun kereta Jakarta Kota. Pada saat ini stasiun Jakarta Kota sudah terintegrasi dengan halte Trans Jakarta.

Gambar 5: Ilustrasi bus transit
Sumber: TOD Standard (2017)

Untuk pengembangan lebih lanjut nantinya stasiun Kota Jakarta akan terintegrasi dengan stasiun MRT yang pada saat ini sedang dalam tahap pembangunan. Dengan adanya titik transit ini dapat dikembangkan menjadi pusat transit di kawasan Kota Tua, seperti yang ditunjukkan oleh Gambar 5.

Pembauran (*mix)*

Pembauran antara beberapa fungsi kawasan menjadi satu bagian dalam jarak pendek pejalan kaki dapat menghidupkan suatu wilayah dimana berbagai kebutuhan dapat diakses dengan berjalan kaki. Percampuran yang seimbang antara fungsi suatu area seperti area rumah tinggal, perkantoran, area perdagangan retail memberikan kesempatan untuk area tersebut menjadi aktif lebih lama dikarenakan akses yang mudah terhadap kawasan tersebut. Termasuk kemudahan akses terhadap taman bermain disekitar yang dapat mendukung suatu kawasan tumbuh lebih baik.

Gambar 6: Ilustrasi pembauran atau mixing, dimana semua fungsi berbaur dari mulai fungsi sosial dengan ruang terbukanya, fungsi komersian dengan pusat perbelanjaannya, dan dekatnya fungsi-fungsi tersebut dengan hunian
Sumber: TOD Standard (2017)

Memadatkan (*Densify)*

Mengoptimalkan kepadatan dan menyesuaikan kapasitas angkutan. Moda transportasi umum yang dapat melayani kota dengan baik mesti cepat, berkala, terhubung dengan baik. Dan dapat diandalkan setiap waktu sehingga dapat menjadi pilihan utama bagi masyarakat untuk berpergian. Kepadatan kota diperlukan untuk mengakomodasi pertumbuhan di area yang terbatas yang dapat dilayani dengan kualitas angkutan umum dan untuk menyediakan penggunanya yang dapat mendorong dan membenarkan pembangunan infrastruktur angkutan umum dengan kualitas tinggi, sesuai dengan Gambar 7.

Gambar 7: Ilustrasi bagaimana memadatkan semua fungsi dalam satu kawasan
Sumber: TOD Standard (2017)

Merapatkan (*Compact*)

Prinsip dasar dari TOD adalah kepadatan: memiliki semua komponen dan fitur penting berada dekat satu sama lain, secara nyaman, dan efisiensi tempat. Dengan jarak yang pendek mempermudah berpergian dari aktivitas satu dengan yang lainnya. Prinsip "*compact*" dapat diaplikasikan pada skala lingkungan, menghasilkan integrasi spasial dengan konektivitas berjalan kaki dan bersepeda yang baik dan orientasi terhadap stasiun angkutan umum, seperti pada Gambar 8.

Gambar 8: Ilustrasi bagaimana merapatkan semua fungsi dalam satu kawasan, sehingga memendekkan jarak dan waktu
Sumber: TOD Standard (2017)

Beralih (*Shift*)

Pengembangan kawasan berdasarkan ketujuh (7) prinsip di atas menghasilkan keadaan dimana kendaraan pribadi tidak lagi berperan penting untuk trasportasi utama. Semua kegiatan transportasi dialihkan menggunakan angkutan umum. Sehingga kerugian dari menggunakan kendaraan pribadi dapat berkurang bahkan secara perlahan permasalahan-permasalahan seperti kemacetan dapat teratasi. Dan ruang kota yang semula diperuntukan untuk akes mobilitas jalan dapat dipergunakan menjadi lahan yang produktif.

Gambar 9: Ilustrasi bagaimana mengalihkan penggunaan kendaraan pribadi ke kendaraan umum
Sumber: TOD Standard (2017)

Studi Preseden

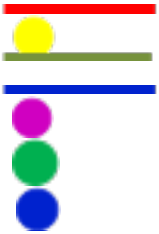
Istanbul yang dalam sejarah juga dikenal sebagai Konstantinopel dan Bizantium, adalah kota terpadat di Turki yang menjadi pusat perekonomian, budaya, dan sejarah negara tersebut. Istanbul merupakan kota lintas benua di Eurasia yang membentang melintasi Selat Bosporus di antara Laut Marmara dan Laut Hitam. Sekitar 12,56 juta turis asing berkunjung ke Istanbul pada tahun 2015, lima tahun setelah penetapannya sebagai suatu Ibukota Kebudayaan Eropa, yang menjadikan kota ini sebagai tujuan wisata paling populer kelima di dunia. Atraksi utama kota ini adalah pusat sejarahnya, yang sebagian di antaranya terdaftar sebagai Situs Warisan Dunia UNESCO.

Gambar 10: Peta Istanbul Turki (batasan kawasan heritage)
Sumber: midafternoonmap (2013)

Pengembangan konsep TOD selalu di mulai pada titik transit angkutan umum yang saling terkoneksi satu dengan yang lainnya, pada studi preseden kota Istanbul Turkey dapat kita lihat pengembangan konsep TOD serta jaringan transportasi umum dan area transit dari angkutan umum tersebut. Gambar berikut jaringan transportasi dan area transit.

Gambar 11: jaringan transportasi dan titik
Sumber: Openstreet.com, 2017

Keterangan:



Jaringan Transportasi Metro
Stasiun Kereta metro
Jaringan Transportasi Metro
Stasiun Kereta Metro
Jaringan Transportasi Trem
Stasiun Transit Kereta Trem
Pelabuhan Perahu

Pada peta di atas dapat disimpulkan jaringan transportasi masal terdiri dari transportasi metro dan trem serta terdapat koneksi antara transportasi trem dengan metro serta trem dengan pelabuhan.untuk lebih lengkap dapat dilihat tabel 1.

Tabel 1. Prinsip TOD pada Kota Istanbul Turki

Penerapan Prinsip Konsep TOD	**Istanbul Turki**
Berjalan Kaki (Walk)	Terdapat jalur untuk para pejalan kaki/ pedestrian sesuai standar TOD
Bersepeda (Cycle)	Terdapat jalur sepeda sesuai standar TOD
Menghubungkan (Connect)	Pola tatanan masa terdiri dari blok-blok kecil sesuai dengan prinsip TOD
Angkutan umum (transit)	Terdiri dari transportasi metro, trem serta bus
Pembauran (mix)	Fungsi bangunan sekitar transit yang terdiri dari berbagai fungsi, seperti fungsi bisnis , hunian, komersial, perdagangan.
Memadatkan (densify)	Transportasi umum saling mendukung dan memadai untuk aktivitas kota
Merapatkan (compact)	Dalam satu kawasan terdiri dari berbagai fungsi yang saling terintegrasi dan saling mendukung.
Mengalihkan (shifting)	Terdapat jaringan jalan yang hanya di khususkan untuk angkutan umum dan pejalan kaki.

Sumber: Hasil analisis, 2017

Tapak Kawasan

Pada penelitian ini berada di kawasan konservasi Kota Tua Jakarta.Dengan luasan wilayah ±86 ha.Dengan stasiun Kota Tua sebagai pusat transitnya.

Gambar 12: Peta Kota Lama Jakarta
Sumber: Guidelines Kota Tua, 2007

Berdasarkan Rencana Induk Kota Tua Jakarta (DTK, 2007), ditengah-tengah Kawasan Cagar Budaya Kota Tua terdapat zona inti, yaitu area yang memiliki nilai sejarah yang lebih bernilai, yang dahulunya sebagian besar adalah kota di dalam dinding. Kawasan Cagar Budaya Kota Tua dibagi menjadi 5 (lima) zona, yaitu: kawasan Sunda Kelapa, kawasan Fatahillah, kawasan Pecinan, kawasan Pekojan, dan kawasan Peremajaan.

Bangunan Cagar Budaya

Berdasarkan kepada beberapa kriteria yang ada di Peraturan Daerah No. 5 tahun 1999, Zona-zona Kawasan Cagar Budaya Kota Tua, dibagimenjadi 3 (tiga) golongan kawasan cagar budaya yaitu:

- Lingkungan Golongan I, di sekitar Taman Fatahillah dan Jalan Cengkeh; - Lingkungan Golongan II, di sepanjang Kali Besar, Jalan Pintu Besar Utara dan sekitar Taman Beos;

- Lingkungan Golongan III, di luar Golongan I dan II yaitu area yang berdekatan dengan Sungai Ciliwung di sisi Timur dan area di dekat Sungai Krukut (Jelakeng) di sisi Barat.

Analisis Terkait Konsep TOD

Kelengkapan sarana dan prasarana serta jaringan infastruktur di kawasan dengan konsep TOD diperlukan agar mendukung serta memaksimalkan pemanfaatannya di kawasan tersebut. Analisis ini dilakukan dengan tujuan menilai kelayakan infrastruktur di dalam

tapak. Prinsip tersebut antara lain ialah sebagai berikut:

Berjalan Kaki (*Walk*)

Titik transit yang utama berada di stasiun Jakarta Kota dimana untuk menjangkau area lainya masyarakat bisa transit berganti moda transportasi menggunakan busway dimana terdapat halte transit dibeberapa titik didalam site serta dapat ditempuh dengan waktu perjalanan 5menit atau dengan radius 500m. untuk pengembangan diketahui berdasarkan data eksisting dimana area yang padat jalur pejalan kakinya dan bagaimana kondisi dan keadaan dari sarana dan prasarana yang ada di lokasi, seperti pada Gambar 13.

Gambar 13: Kondisi Jalur Pejalan Kaki
Sumber: Dokumentasi Pribadi (2017)

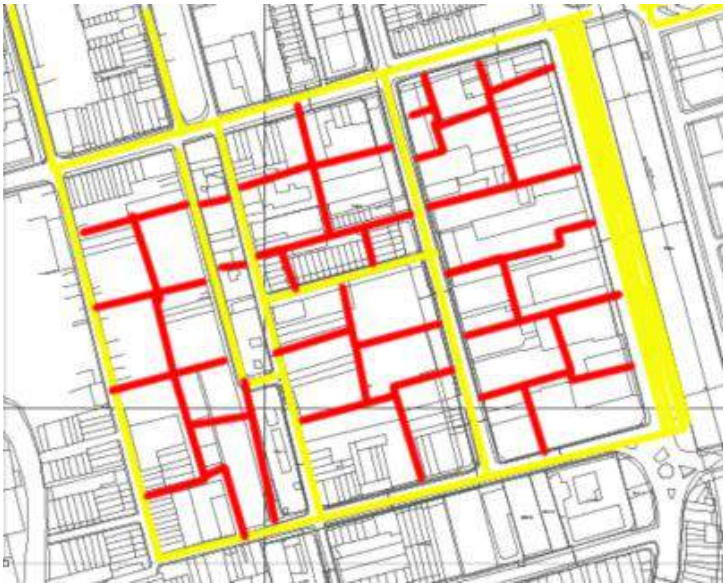
Bersepeda (*cycle*)

Jaringan trasnportasi yang digunakan dalam TOD ialah bersepeda yakni ketersediaan jalur sepeda yang layak dan sesuai dengan standar menjadi tolak ukur suatu kawasan dengan konsep TOD berhasil atau tidak. Jaringan tersebut termasuk jaringan jalan untuk bersepeda yang aman dan nyaman serta fasilitas parkir sepeda di lokasi tapak yang aman, ditunjukkan oleh Gambar 14.

Gambar 14: Tidak terdapat jalur sepeda di tapak
Sumber: Dokumentasi Pribadi (2017)

Menghubungkan (*Connect)*

Menguhubungkan dalam prinsip TOD yakni mempersingkat jarak menuju suatu lokasi serta tersedianya banyak pilihan rute yang dapat ditempuh degan berjalan kaki dan jalur sepeda. Menghubungkan bisa dengan meredesign blok-blok yang panjang yang terdapat di dalam site menjadi blok-blok serta menata kembali jalur pejalan kaki dan jalur sepeda yang terdapat pada blok-blok kecil yang sudah ada di tapak. Pada skema gambar dibawah ini terlihat pembagian blok pada tapak, seperti pada Gambar 15.

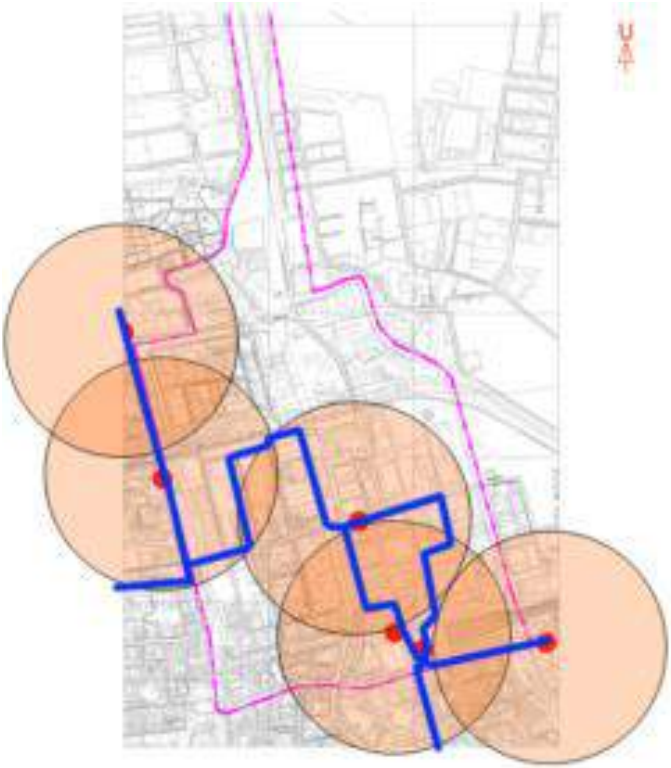


Gambar 15: Blok kawasan saling terkoneksi
Sumber: Dokumentasi Pribadi (2017)

Angkutan Umum (transit)

Angkutan umum merupakan inti utama dari kawasan dengan konsep TOD semua penyebaran selalu dimulai dari titik transit angkutan umum. Dan menerus ke area yang dapat dijangkau dengan berjalan kaki dengan waktu tempuh 5 m (500 m) seperti yang terlihat pada skema titik transit dan radius pejalan kaki pada gambar 16 di bawah. Dimana saat ini penyebaran titik transit tidak merata keseluruh site, terdapat area yang tidak terjangkau oleh radius pejalan kaki.

Penyebaran titik transit diambil berdasarkan jarak ideal pejalan kaki untuk mengakses titik transit tesebut. Jika dilihat secara garis besar maka titik transit ideal didalam kawasan berjarak kurang lebih 1 kilometer antara satu dengan yang lainnya. Dan mempertimbangkan kondisi sekitar apakah menarik atau tidaknya titik transit tesebut, serta potensi di sekitar titik transit yang dapat dikembangkan sesuai dengan prinsip-prinsip TOD. Pertimbangan penentuan titik transit di dalam kawasan, seperti pada Tabel 2.

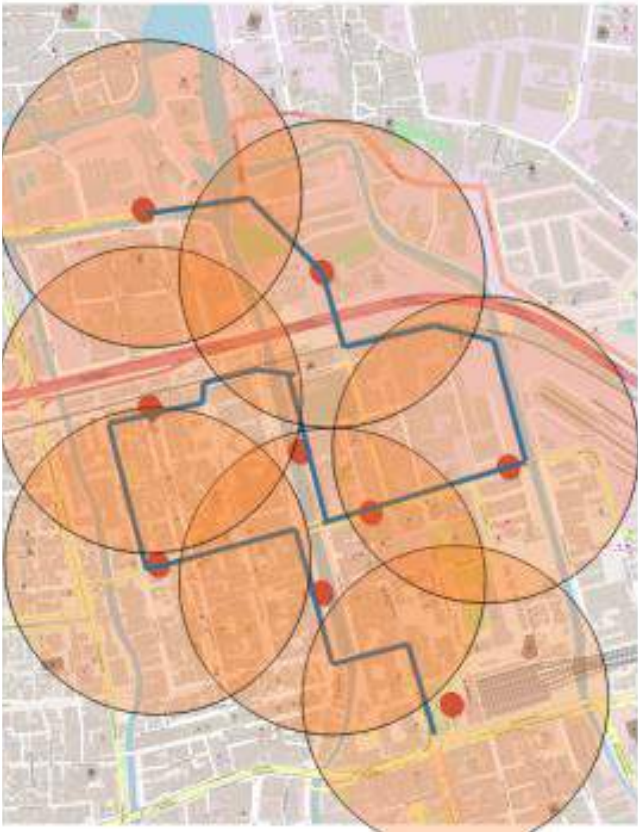


Gambar 16: Titik transit dan jalur Trans Jakarta
Sumber: Dokumentasi Pribadi (2017)

Tabel 2. Potensi Titik Transit di Dalam Kawasan.

No	Titik Transit	Potensi Sekitar Titik Transit
1	Titik Transit 1 Stasiun Beos-eksisting	-Stasiun Beos -Museum Mandiri -Museum Bank Mandiri -Bank Mandiri -Gedung Asuransi Jasindo
2	Titik Transit 2 Jalan Kali Besar Barat- eksisting	-Museum Wayang -Toko Merah -Ex Bank Standard Chartered Hindia Belanda -Kali Besar
3	Titik Transit 3 Jalan Kopi	-Bangunan konservasi tipe B dengan fasad yang menarik -Area kawasan pengembangan
4	Titik Transit 4 Jalan Tiang Bendera	-Area pertemuan dengan jalur LRT Kemayoran-Bandara Soetta
5	Titik Transit 5 Jalan Kali Besar Timur	-Area Pujasera Pemprov DKI -Gedung PT Jasa Raharja -Jembatan Merah -Kali Krukut
6	Titik Transit 6 Halte Museum Fatahillah- Eksisting	-Museum Fatahillah -Kafe Batavia -Gedung PI Jakarta Lyord -Dasaad Musid Concern -Kantor Pos Jakarta Kota -PT Asuransi Jasindo -Museum Wayang
7	Titik Transit 7 Jalan Kunir	-Gedung Geo Wehry & Co -Museum Keramik -Hotel 1001
8	Titik Transit 8 Jalan Tongkol	-Area pengembangan kawasan
9	Titik Transit 9 Jalan Tongkol-Jalan Pakin	-Galangan VOC -Menara Syahbandar -Museum Bahari -Pelabuhan Sunda Kelapa -Pasar Ikan

Sumber: Dokumentasi Pribadi, 2017



Gambar 17: Area transit di dalam tapak
Sumber: Dokumentasi Pribadi (2017)

Berdasarkan tabel di atas dapat disimpulkan penempatan titik transit yang berpotensi di dalam kawasan Kota Lama Jakarta dapat dilijat pada gambar 17.

Pembauaran *(mix)*

Pembauran atau *Mix* ialah menyatukan beberapa fungsi menjadi satu seperti menyatukan fungsi permukiman dengan fungsi retail. Konsep TOD yang terpusat menggunakaan transportasi umum membuat daerah sekitar titik transit berkembang menjadi kawasan yang multifungsi. Dimana area tersebut mudah dijangkau oleh pejalan kaki sehingga dari titik transit sejauh radius 500m menjadi area yang yang akan menjadi area pembauran. Dapat dilihat melalui gambar di bawah ini bagaimana titik transit mempengaruhi daerah sekitarnya.

Gambar 18: Titik transit dan jangkauan berjalan kaki 5 menit (500 m)
Sumber: Dokumentasi Pribadi (2017)

Memadatkan *(densify)*

Mengoptimalkan kepadatan angkutan kawasan berdasarkan kebutuhan transporasi umum yang maksimal dimana secara perlahan penggunaan terhadap kendaraan pribadi berkurang dan masyarakat terfokus menggunakan angkutan umum. Sejalan dengan berkembangnya transportasi umum yang mendukung. Peningkatan transportasi umum yang semakin cepat membantu mobilitas masyarakat sekitar menjadi lebih baik sehingga menghasilkan kegiatan ekonomi yang berkembang di sekitar titik transit.

Merapatkan (*Compact*) Kerapatan akan suatu kawasan menjadikan kawasan tersebut dekat antara satu dengan yang lainnya dimana secara merata dari titik transit menjadi lebih berkembang dengan banyak pilihan kebutuhan yang akan muncul. Dengan jarak tempuh yang dekat memberikan produktifitas yang tinggi. Pada kawasan konservasi merapatkan berarti menghidupkan kembali kawasan kota tua sengan berbagai fungsi yang mendukung pertumbuhan kota sebagai kawasan heritage yang dilingdungi.

Beralih *(shift)* Tujuan dari prinsip beralih ialah mengurangi pemakaian kendaraan pribadi seminimal mungkin. Penduduk diarahkan untuk berjalan kaki , bersepeda dan menggunakan angkutan umum yang layak dan baik untuk melakukan aktifitas. Sehingga permasalahan yang sering muncul akibat kendaraan pribadi bisa diatasi.

KESIMPULAN

Konsep TOD dapat menjadi solusi untuk mengatasi permasalahan di Kota Tua Jakarta.Dengan penyebaran titik transit yang merata akses di dalam kawasan Kota Tua menjadi lebih mudah serta dapat menarik minat masyarakat untuk menggunakan transportasi umum.sehingga berkurangnya penggunaan Kendaraan pribadi dan beralih ke penggunaan transportasi masal.

DAFTAR PUSTAKA

Biro Perencanaan dan Kerjasama Luar Negeri, Kementerian Pendidikan dan Kebudayaan. 2016. *World Culture Heritage* (WHC). http://kniu.kemdikbud.go.id/sektor/kebudayaan /world-culture-heritage-wch/, diakses tanggal 24 Oktober 2017 pukul 00.40 WIB.

Calthorpe, Peter. 1990. *Transit-Oriented Development Design*

Guidelines, Penerbit Calthorpe Associates in Assocition with Mintier & Associates, USA, diakses tanggal 25 Oktober 2017 pukul 02.01 WIB.

Gubernur Provinsi DKI Jakarta. 2014. *Rencana Induk Kawasan KotaTua*. http://dcktrp.jakarta.go.id/beranda/peraturan/PERGUB_NO_36_TAHUN_20141%20RENCANA%20INDUK%20KAWASAN%20KOTA%20TUA.pdf, diakses tanggal 27 Oktober 2017 pukul 22.10 WIB.

ITDP. 2017. *TOD Standard 3.0*. http://www.itdp-indonesia.org/featured-pub- 4/tod-standard-3/, diakses tanggal 27 Oktober 2017 pukul 22.13WIB.

Purwantiasning, Ari .W, dkk. 2012. Tipologi Konversi Bangunan Tua Di Pusat Kota Studi Kasus Pecinan Di Singapura Dan Petak Sembilan Di Jakarta. Jurnal Nalars UMJ, diakses tanggal 29 Desember 2017 pukul 01.30 WIB.

#03

Modern Thought of Photovoltaic Technology in the Implementation of Transit Oriented Development's Concept and Revitalization for Jakarta Old Town

KOLABORASI

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ABSTRACT

The idea of this research is based on the development of the city which has a historical area, particularly Jakarta Old Town, which is become abandoned in some part area. The main problem of this research is how to implement of Transit Oriented Development's concept for historical buildings within the historical area and modern thought using photovoltaic technology. By doing a precedent study of some case studies, this research will give an alternative solution for local government to maintain historical area by combining between old and modern concept. As an outcome, this research will give a solution how to use the technology of photovoltaic in the implementation of Transit Oriented Development for historical area particularly Jakarta Old Town Area in Indonesia.

Keywords: photovoltaic technology, transit oriented development, historical area, Jakarta Old Town Area

INTRODUCTION

The existence of many abandoned historical areas within the city center has encouraged an awareness of some parties particularly historians and conservators. Moreover, because there is a need to promote the identity of the city, local government has been encouraged as well to consider the issues of those abandoned historical areas. One of the significant issues of those abandoned historical areas is the lack of the maintenance as well as the lack of the utilities within the areas.

The problem of lack of the infrastructure within those abandoned historical areas will make the areas have a degradation of the quality. One of the concepts is by delivering the synergy concept within the areas to improve the quality of the built environment as well as the quality of the community who lives in the areas. We have studied the conservation within the area of Jakarta Old Town with a different point of view. In this research, we have tried to propose the application of Transit Oriented Development within historical areas particularly the area of Jakarta Old Town. The problem within this area is the lack of comforts and safeness for pedestrian, especially all visitors within the area of Jakarta Old Town.

To support the implementation and the using of Transit Oriented Development, we have proposed the use of photovoltaic technology as a concept of using renewable energy. The using of

this technology will cover in the use of electricity for the transportation within the area of Jakarta Old Town, which is in this case, we have proposed a tram as a public transport, and the use of lighting for night use.

By integrating this two field study of electrical engineering (control system) and architecture (urban planning), we have tried to give a conceptual idea which could be used as a pilot project to implement a concept of Transit Oriented Development based on photovoltaic technology.

RESEARCH METHOD

This research have conducted an area of Jakarta Old Town as a case study, which is very well known as a historical area in Jakarta. This area has been designated as a case study because this area has

a significant historical value which could become the identity of the city and has a glorious in the past. The method of the research is qualitative research with a historical approach to describe the condition of the area either physical or non-physical aspects. At the end of the study, we have provided design as a result.

THE CONCEPT OF TRANSIT ORIENTED DEVELOPMENT

One of the issue within the area of Jakarta Old Town is the lack of comforts and safety for pedestrian especially the visitor of the area of Jakarta Old Town. The traffic in surrounding area of Jakarta Old Town has been regarded as a crowded one. Some areas within Jakarta have implemented the concept of Transit Oriented Development to tackle the problem of the traffic in Jakarta. To solve the problem within the area of Jakarta Old Town, the researchers have proposed a concept of Transit Oriented Development within the area. By implementing this concept, the area of Jakarta Old Town become integrated from one facility to another facility within the area. One of the main concepts of Transit Oriented Development is by providing the accessibility for pedestrian, transit for public transport to enhance the quality of the environment to be a comfort, safe, attractive and sustainable one.

Referring to the area of Jakarta Old Town, there are many visitors either domestic or international, and this condition has encouraged the area to be more attractive and has been improved physically

and non physically. We believe that this proposed solution by implementing the concept of Transit Oriented Development within the area of Jakarta Old Town will enhance the quality of the area and will encourage visitors to come. The concept of Transit Oriented Development will improve the character of the area as well because the concept will deliver facilities and accessibilities for pedestrian as well as the transit for public transport.

As Wijaya (2009) said that the concept of Transit Oriented Development had been started by promoting the concept of human mobility activity either with vehicles or by walking. Human mobility has been regarded as an activity which has been done a lot by the human and has been accommodated by the central activities which are integrated by transit points. These central activities have been connected one to another with comfort and safe radius as an effort to decrease the use of transportation [1].

It could be concluded that the concept of Transit Oriented Development is a concept to integrated all the accessibility using pedestrian way to minimize the mobility of public transport. This concept also to design the comfort and safe accessibility within the area which is walkable for visitors. Thus, to propose the concept, we have analyzed the condition of the area of Jakarta Old Town, and will promote the alternative solution by providing the concept of Transit Oriented Development within the are by using a tram to minimize the distance of the area. This is because the condition of

the area from one attraction to another is relatively far. Thus, this using of a tram will make the area more walkable to catch the attraction as near as possible for visitors.

PHOTOVOLTAIC TECHNOLOGY

Energy thermal that 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. Another benefit of solar energy is to produce electricity through the using of a photovoltaic cell. The using of electrical energy from solar energy could become renewable energy for the future. Some researchers have done and stated that the using of solar energy becomes electrical energy has minimized the use of electrical energy. Referring to the previous research of Purwantiasning, et al. (2017), 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% [2].

According to that, we have proposed the using of technology photovoltaic within the area of Jakarta Old Town. The implementation of this technology will cover the using of the tram as public transport within the area, the using of lighting within the area at night time and the using of the lighting within some designated historical buildings within the area.

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 could be defined as a process to convert light energy (sun) become electrical energy.

Figure 1. Natural lighting from sun
Source: http://4.bp.blogspot.com, has been accessed on 31st December 2016

Quote from the book Basic Photovoltaic Principles and Methods (1982); it has been stated that the physical phenomenon responsible for converting light to electricity-the photovoltaic effect was first observed in 1839 by a French physicist, Edmund Becquerel. Becquerel noted 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 [3].

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 [3].

THE AREA OF JAKARTA OLD TOWN

In this chapter, we have discussed the area of Jakarta Old Town, from the physical condition to non-physical condition. We have also discussed the regulation and the planning of the area of Jakarta Old Town as a designated area of conservation. By referring this regulation and the planning of Jakarta Old Town

area, have analyzed the possibility to propose the concept of Transit Oriented Development using technology photovoltaic.

Figure 2. The Zones of Jakarta Old Town's area from Zone 1-Sunda Kelapa, Zone 2-Fatahillah Square, Zone 3-Pecinan or China Town, Zone 4- Pekojan or Kampung Arab, Zone 5-Kawasan Peremajaan or Rejuvenation's Area. The core zone of the Jakarta Old Town is zone 2 which is covered the area of Fatahillah Square and the surrounding area.
Source: Rencana Induk Kota Tua Jakarta, 2008 [4]

Referring to Rencana Induk Kota Tua Jakarta (2008)- Master Plan of Jakarta Old Town, the area of Jakarta Old Town has some significant issues as well as significant potencies that could be promote to maintain the area to be a good built environment. There are some significant issues that have been defined as follow [4]:

1. Bad image of the area: an image that this area is full of polution, traffic jam every where, crowded, unsafe and slum.
2. The lack of vitality of the area: the variety of the activities within area is not compatible and it is not optimal in promoting the potency of historical old buildings within the area ; there is unintegrated development within area
3. The lack of infrastructure within area which is not supported the development of the area: abandoned drainage, lack of pedestrian ways
4. The unorganized traffic within the area which affected the traffic jam, crowded, lack of accessibility to the area of attraction, unintegrated parking area
5. The significant degradation of the quality of built environment: air polution, water polution
6. The unintegrated policy: the separated regulation and policy between official division, unresponsive bureaucracy
7. Separated administrative border: the area still under two district: North Jakarta and West Jakarta
8. There is not institutional office available which has an entrepreneur skill and has an authority to plan, develop,

market and control the strategy of the development of Jakarta Old Town.

On the other hand, there are also some significant potencies of the area of Jakarta Old Town as follow [4]:

1. The area of Jakarta Old Town was an international port area in the colonial era and it became the embrio of Jakarta and mixed community.
2. The heterogeinity of the society has been formed from the mixed culture from several ethnic (Chinese, Arabian, Dutch, England and Malay).
3. The structure of the city that has been formed at the riverside is similar with the cities in Ducth, with Ciliwung River as the center of economic activity.
4. The center marine tourism activity in the past played an important roled in the aspect or area's development (government, social-politic, population, art and culture)
5. The support of infrastructure for road transportation as well as canal transportation will broaden the area of Jakarta Old Town to Glodok and Pasar Baru area.
6. There are so many architectural heritage from the colonial era, which have a Europian architecture style from 17 century.

Figure 3. One of the significant historical building within the area of Jakarta Old Town. The building very well known as Fatahillah Museum which is located in Fatahillah Square, the core zone of the area of Jakarta Old Town
Source: Private Documentation, 2018

According to the Master Plan of Jakarta Old Town [4], the development of the area of Jakarta Old Town will cover some points to solve the issues within the area. All the points will include:

1. To strengthen the existing activities within the area and to encourage the development of new busnisess and economic activity;
2. To conserve and revitalize in the developing the area of Jakarta Old Town

3. To enhance the quality of infrastructure and public facilities within the area
4. To support the activity of social, art and culture within the area
5. To restore the main function of the area as a resident area with all supported activities
6. To develop the concept of public-private partnership through institusional system, law and urban management.

Referring to all the above significant issues, potencies and the strategy, the researchers could underlined that the development of the area of Jakarta Old Town should cover all aspect from economic, social and activities which is based on community's need. Through the observation and literature studies, the researcher believe that the core zone is the best choice to conduct the concept of Transit Oriented Development within the area of Jakarta Old Town. This is because, the area of core zone has been regarded as an special area with significant character and has more appreciation to the memory of past in the colonial era. This core zone also has a function as a central orientation and central of the living heritage within Jakarta Old Town. This area has a high limitation in the development activities, because there are many historical building with grade A.

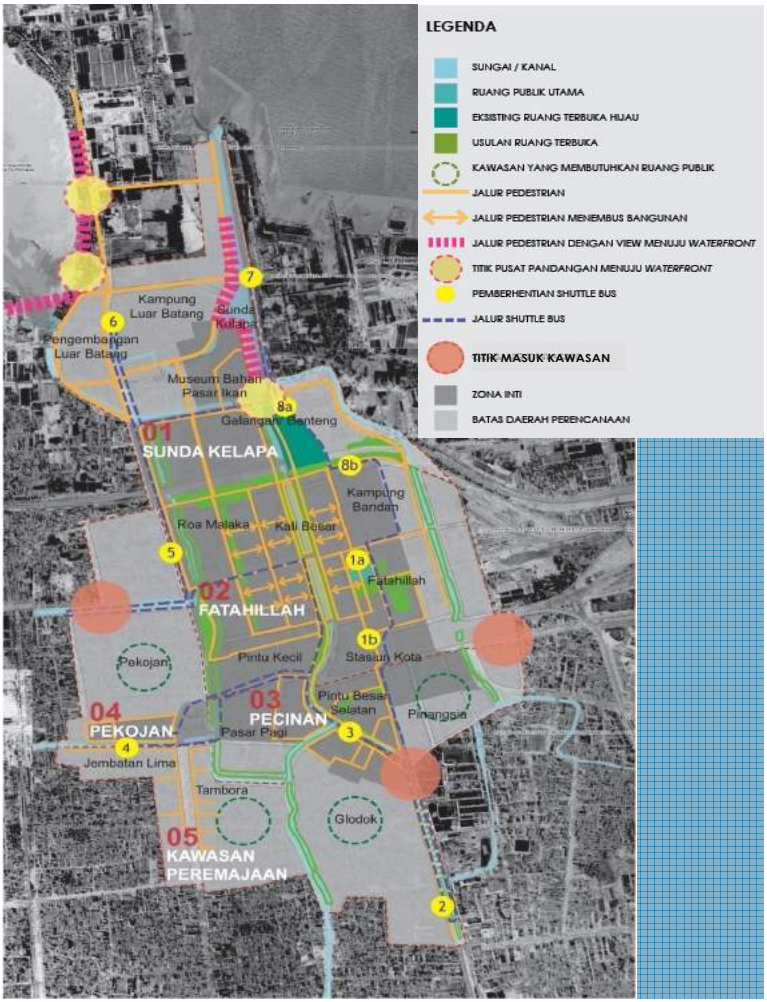

Figure 4. The above map shows the streets, pedestiran ways also the open space and green area within the area of Jakarta Old Town
Source: Rencana Induk Kota Tua Jakarta, 2008 [4]

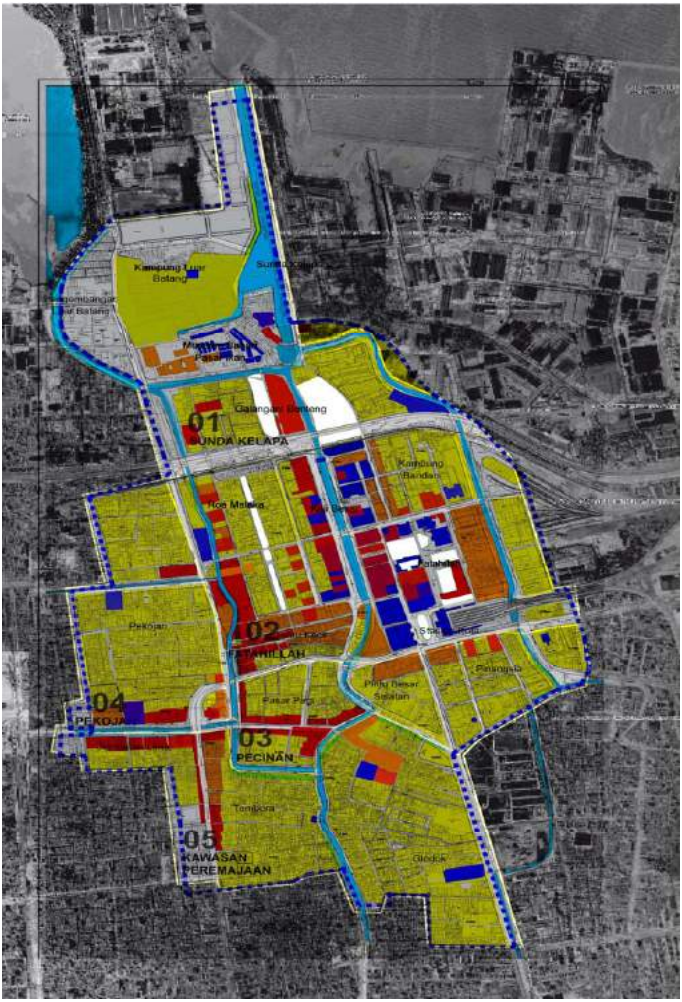

Figure 5. The above map shows buildings within the area of Jakarta Old Town with Grade A (blue color), Grade B (red color), Grade C (orange color) and Grade D (yellow color)
Source: Rencana Induk Kota Tua Jakarta, 2008 [4]

The main principle of the development within the area of Jakarta Old Town is the circulation of pedestrian as well as the vehicles and also the linkage between one point to another. The development within the area should provide the circulation system that comfort, safe and continue and refer to the urban planning in macro scale. The development also should maintain the traffic management to minimize the traffic jam and crowd within the area to control the capacity and the mobilization of people and vehicles. The development also should cover the improvement of transportation system which cover the delivery and mobilization of visitors within the area without interfere the mobilization of pedestrian.

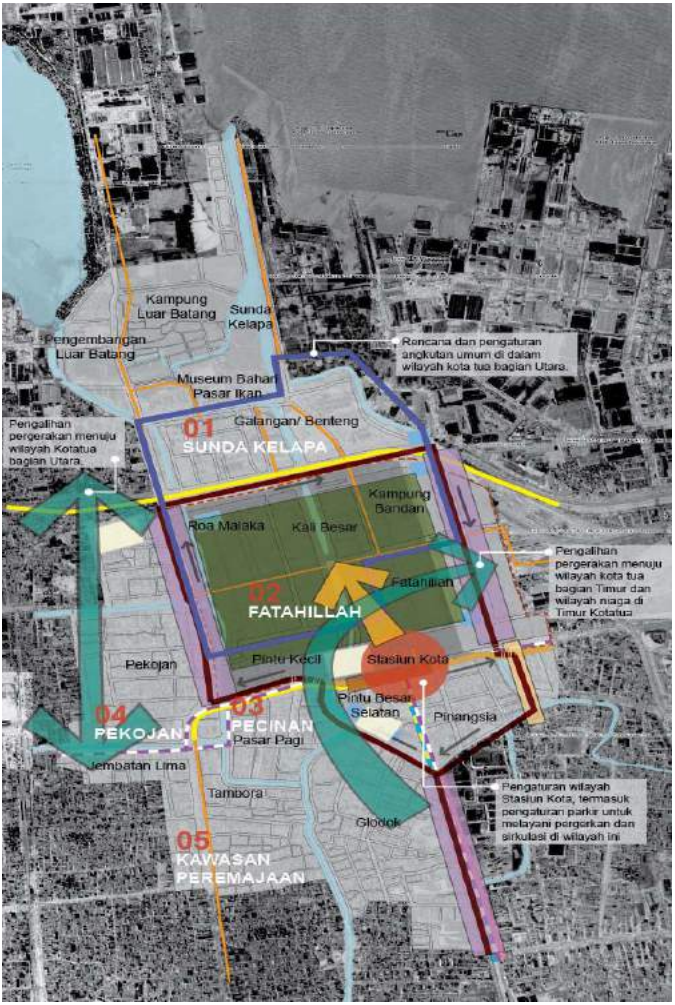

Figure 6. The above map shows the circulation and the linkage within the area of Jakarta Old Town which is stated in the Master Plan of Jakarta Old Town
Source: Rencana Induk Kota Tua Jakarta, 2008 [4]

According to figure 6, the Master Plan of Jakarta Old Town has described the linkage and circulation within the area of Jakarta Old Town. The map shows the principle of the development of pedestrian way. The area Jakarta Old Town should be oriented to the comfort of pedestrian. Thus, there should be a development of pedestrian ways within the area. There should be a consideration that there is a limitation of range for walking. Either the area is walkable or not, the development should consider about it. The accessibility should be comfortable for pedestrian, and the distance of the attraction from one point to another should be considered as well.

Using the regulation and the Master Plan of Jakarta Old Town, we have tried to propose a design by developing the circulation for visitors using a tram through tourism line between historical building within the area of Jakarta Old Town. This tram will be operated by using renewable energy well known as technology photovoltaic.

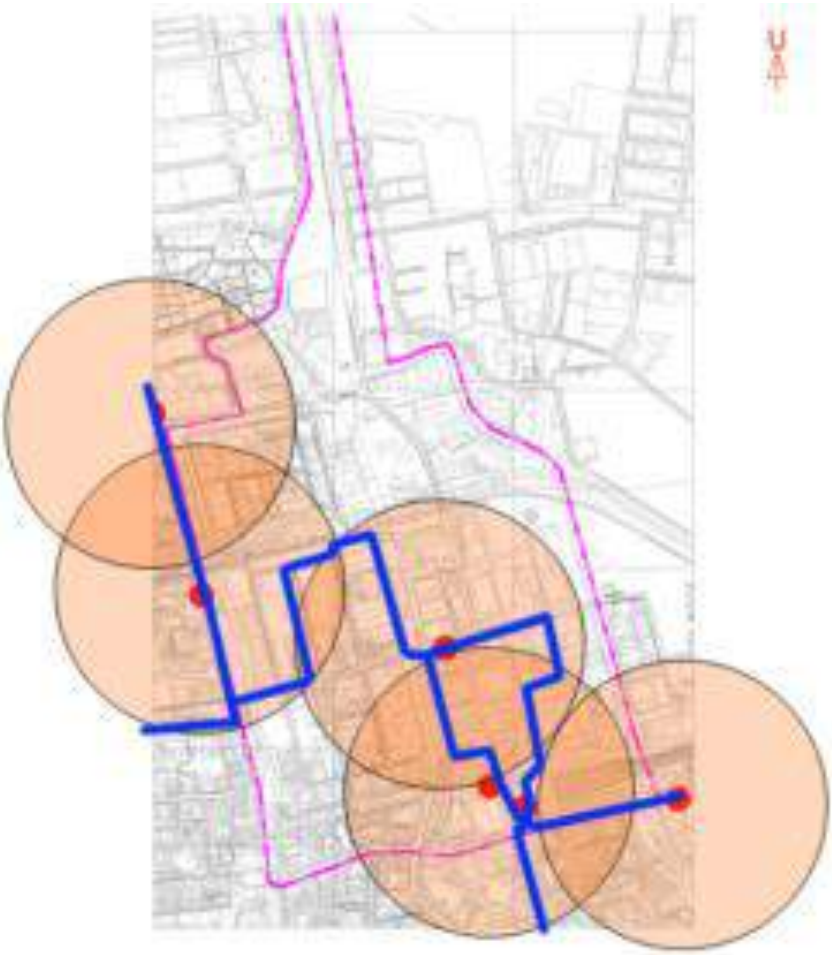

Figure 7. The above map shows existing public transport, the point of transit and Trans Jakarta line
Source: Analyze Result, 2017

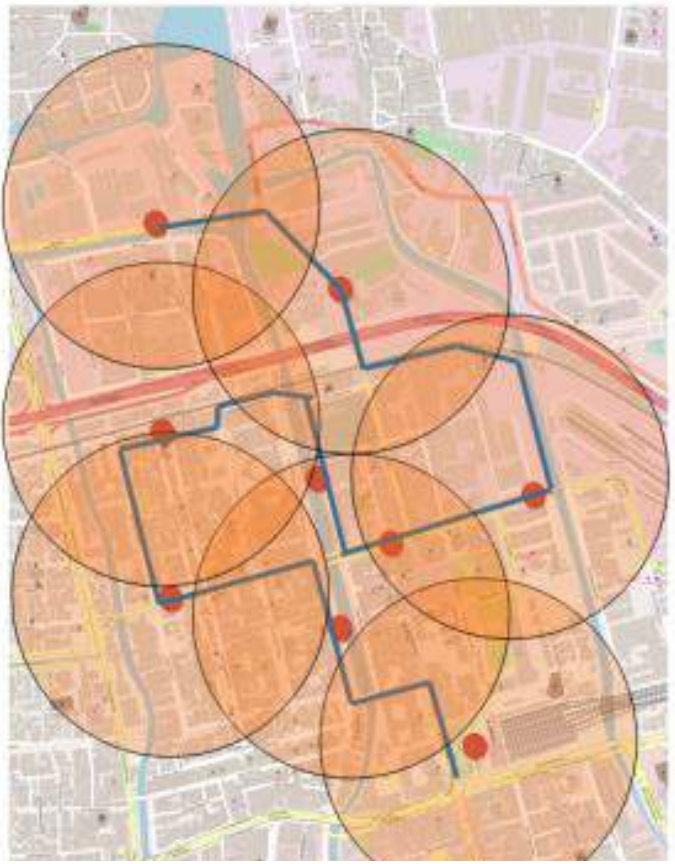

Figure 8. The above map shows the development of transit point according to the analyze of figure 7
Source: Analyze Result, 2017

Through the above figure (figure 8), we have proposed the line for the tram which will cover the area of Jakarta Old Town using the principle of maximum distance of walking (500 meters or 5 minutes walk).

CONCLUSION

The concept of Transit Oriented Development could become the best solution to handle many issues in the Jakarta Old Town's area particularly the issue of comfort and safe for pedestrian as well as the issue of traffic and crowded.

By distributing some transit point throughly within the area of Jakarta Old Town, pedestrian will access easily to all attraction point from one to another.

This condition surely will enhance the quality of the build environmet as well as to improve the number of visitors within the area. The comfort and safe place within the area will encourage visitors to come to Jakarta Old Town using public transport, this will support to minimize the using of private vehicles.

REFERENCES

[1] Wijaya, A. *Penataan Ruang Yang Ramah Lingkungan Melalui Perencanaan TOD*. Universitas Langlangbuana. Bandung. (2009).

[2] Purwantiasning, AW; Bahri, S. *An Application of Smart Building Concept for Historical Building Using Automatic Control System, Case Study: Fatahillah Museum.* International Journal of Built Environment and Scientific Research. Universitas Muhammadiyah Jakarta. **Volume 1 No. 2 Ed. December 2017.** (2017).

[3] The Midwest Research Institute. *Basic Photovoltaci Principles and Methods*. Solar Energy Research Institute. Colorado. United States of America. (1982).

[4] Dinas Tata Ruang Pemerintah DKI Jakarta. *Rencana Induk Kota Tua Jakarta-Master Plan of Jakarta Old Town*. Pemerintah Kota DKI Jakarta. (2008).

#04

Understanding the TOD Concept of Historical Areas Through Precedent Studies

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ABSTRACT

This research is part of multi-year research, which is undertaken for two years. It aims at understanding the implementation of TOD concept through precedent studies. The significance of this research is the areas of precedent studies of historical areas within metropolitan cities. The idea of TOD itself has been regarded as a perfect solution for a metropolitan city which has a relatively large population. This research has conducted historical areas for the study because the concept of TOD has been promoted as a perfect solution to improve and enhance the quality of life of the historical areas (the built environment and the local community itself). This research has implemented the qualitative method using precedent studies as a way of thinking to get the typology of the historical district which used the TOD concept. We have conducted two precedent studies which have a historical area within a metropolitan city. They are Hong Kong with Kowloon Historical Area, and Turkey with Istanbul Historical Area. Each precedent study has described their significance and uniqueness of their character of the historical area. From this initial study, we have concluded the character of the historical area in each precedent studies, and we have underlined the typology of the implementation of TOD concept within the historical area.

Keywords: Transit Oriented Development, Historical Area, Kowloon, Istanbul

INTRODUCTION

The existence of many historical buildings within historical areas in the metropolitan city has encouraged many parties to have the willingness to protect, preserve and conserve them as assets of cultural heritage particularly architects, planners, and historians. This condition also has encouraged either Local Government as well as Central Government to initiate a programme which is related to the issues of historical buildings particularly in maintaining and enhancing their quality. The main problem arisen for historical buildings is a lack of utilities and lack of maintenance. This condition because the cost of the maintenance is relatively high, and usually government has a minim budget to handle this issue. In some developed countries, to solve the problem, local government and central government have a partnership with the private sector to finance the maintenance of historical buildings.

One of the main problems within historical area particularly related to a historical building is the lack of utilities which is one of it is lack of infrastructure within the historical area. This condition will degrade the quality of the historical areas particularly the quality and performance of historical buildings. One of an alternative solution to solve this problem is by providing new concept which is synergized to improve and enhance the quality of the built environment as well as the quality of the local community who live within the historical area.

Historical attachment of local community has been regarded as an essential thing in the designation process of the historical area. The historical attachment also become an appropriate approach in digging up the level of emotional and memory of an individual to cultural heritage, in this case, is a historical area with historical buildings within it (Madgin, 2013)[1]. By using this approach, the need of the local community could be revealed to the sustainability and their need for the historical area. The necessity of infrastructure itself could be reached by implementing the concept of Transit Oriented Development which prioritizing the need of comforts and safeness for pedestrians, in this case, is the visitors and the local community of historical site. As mentioned by Taki et.al (2018) [2], that the well-regulated city is characterized by the conditions of land use and transportation systems and it indicates economic prosperity.

This research is aiming to provide a conceptual idea and suitable thought about how to synergize the concept of Transit Oriented Development with historical attachment approach 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 two precedent studies to have an understanding of Transit Oriented Development concept. By understanding the concept of Transit Oriented Development through these two precedent studies, it can be concluded and underlined the typology of historical areas which are using the concept of Transit Oriented Development. 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.

THEORY OF TRANSIT ORIENTED DEVELOPMENT

Basic Concept of Transit Oriented Development

As mentioned in Purwantiasning (2017) [3], TOD which stands for Transit Oriented Development could be defined as "an integrated urban place designed to bring people, activities, buildings and public space together, which easy walking and cycling connection between them and near excellent transit service to the rest of the city…." [4]

To conclude the definition of TOD, Purwantiasning (2017) [3] also explained that a district of an area which implemented the concept of TOD is an area or a neighborhood that could be said as an area or a district which could accommodate the community in doing many activities within it. In other word, this area or district should have various zones, not only for residential but also for commercial, public use, and green space [5]. To underline that statement, it also could be said that an area or a district which implement the Transit Oriented Development concept could be developed by thinking of the need of pedestrians and bikers. It means that mostly the circulation way within an area of TOD should be provided for those users (pedestrians and bikers). The

dimension, size, and numbers also become an essential thing to be considered in the area with TOD concept, because the circulation way should accommodate more for pedestrians and bikers rather that for vehicles. According to these matters, it can be concluded that an area or a district with TOD concept should be designed and planned to be near to the public transportation system (MRT, LRT, Bus Station) that could be accessed by walking distance, and this public transportation could deliver the people to the city center comfort and safe [5].

Basic Principles of Transit Oriented Development

Purwantiasning (2017) [3] has mentioned, referring to TOD Standard Book from Institute for Transportation and Development Policy (2017) [4], it has been explained that there are some basic principles of the Transit Oriented Development concept that should be fulfilled in the implementation of the concept. All these fundamental principles should be completed and accomplished in the design, plan and to develop an area or a district in the application of Transit Oriented Development. There are eight principles in the Transit Oriented Development concept, as follow:

1.Walking

Basically as mentioned in the basic concept of Transit Oriented Development, the area or district which implemented this concept should provide the circulation way for the pedestrian. The activity of walking is a primary in the area or district with the TOD concept. This principle is encouraging the planner, architect, and developer to develop the area or district which promote walking

as a primary and fundamental principle. Walking is a natural activity of human being, which is considered as a healthy, a clean, an efficient, an affordable and an effective way to get from one place to another which is accessible for all people. Also, it could be said, that walking is one essential component that will be needed in almost all traveling which using the transit system. By promoting this principle, a sustainable environment could be reached.

2.Cycling

As mention in the above chapter, that an area or district with the TOD concept should have a priority for pedestrians and bikers. Walking activity is an activity for pedestrian, and cycling is an activity for bikers. To fulfill this principle, the area or district with the TOD concept should provide a cycling path. This principle has been regarded as a second primary activity which is a healthy, an affordable and an inclusive mode of mobility within an urban area fastly.

3.Connecting

The basic concept of TOD is to connect one function to another in one area or district. Developing an area which has a crowded network for transportation with roads, streets, and ways, will encourage the urban planner to design and plan the area of TOD with a familiar environment for users. The good design of an area or district with the TOD concept will enhance the cognition of the

users. Also, the compact network of roadss, street, ways will connect between one function to another one.

4.Transiting

According to the terminology of TOD which stands for Transit Oriented Development, it could be underlined that the area or district which implemented the TOD concept should be near to the mass or public transportation facility which has good quality. Purwantiasning (2017) [3] also mentioned that accessible mass transportation facility for pedestrian will encourage people to walk and use the pedestrian way, and people will no longer use a private vehicle to go to one place to another.

5.Mixing

One of the principles in the concept of Transit Oriented Development is by mixing some function, activities, uses, needs with the variety of economic level and demography condition of the community within the designated area or district. The planning or the area should consider many aspects either physically or non-physically.

6.Densifying

The concept of Transit Oriented Development usually has been implemented in the metropolitan cities, which are regarded as cities with high density of population. To maximize the density of

the area, the planner should consider by densifying the area or district to justify in accommodating all community. One of the solutions is by providing mass transportation and vertical housing within the area or district.

7.Compacting

Compactness is one of basic guiding principle in the concept of Transit Oriented Development. Proper planning and design of an area or a district with Transit Oriented Development concept should provide a space or a zone which have an accessible distance from residential zone to the mass rapid transportation facility. By delivering compactness within an area or a district, all facilities within an area or a district could be accessed easily to reach comfort, safeness, efficiency, and reliableness.

8.Shifting

Within an area or a district with a concept of Transit Oriented Development, the mobility of people is highly recommended and encouraged. To reach this goal, the planning and design of the area or district should consider the possibility of people doing many activities within the area by shifting one activity to another without using any private vehicles. Parking area and street, as well as pedestrian ways and bicycle ways, should be well organized to minimalize the use of private vehicles.

In metropolitan cities, the development of Transit Oriented Development (TOD) model has been proposed with the aim of developing the TOD model and of determining potential areas of TOD as mentioned by Rahmat, et.al (2013) [6]. Rahmat, et.al (2013) also stated that the method has also the aim of being an effort in providing the suitability of the implementation of TOD concept for creating a systematic and comprehensive implementation of transit stations in urban areas to overcome the problem and conflict of traffic congestion. i.e. it can be used as a guide to determine the potential areas of TOD by local government or planners to solve the problem of rapid and massive urbanization recently. Rahmat, et.al also believed that the proposed model has also the effect of increasing the level of implementation of project development in the transport planning phase, as detailed requirements of the determining the potential areas of TOD process [6].

RESEARCH METHOD

This research has implemented the qualitative method using precedent studies as a way of thinking to get the typology of the historical area which used the TOD concept. We have conducted two precedent studies which have a historical area within the metropolitan city, and have a significant character. The two precedent studies are Hong Kong with Kowloon Historical Area, particularly Tsim Sha Tsui District, and Turkey with Istanbul Historical Area, particularly Sultan Ahmet District. Each precedent studies have described their significance and uniqueness

of their character of the historical area. From this initial study, we have concluded the character of the historical area in each precedent studies, and we have underlined the typology of the implementation of TOD concept within the historical area. Using eight principles of Transit Oriented Development [4], this research has described and analyzed one by one of those principles.

DISCUSSION OF PRECEDENT STUDIES

Kowloon Historical Area of Hong Kong

Kowloon district is one of a historical district in Hong Kong (see Figure 1). There are some historical buildings within this area which represented victorian architecture with redbricks and big columns. This area has been regarded as the busiest district in Hong Kong, since that this area has been regarded as a central district in Hong Kong. One of the area within Kowlon district is Tsim Sha Tsui, which has a significant character of buildings and atmosphere. There are some particular plots which represented the historical area of Hong Kong. They are Mongkok Ladies Market, Kowloon Park, Former Kowloon British School, St Andrew's Church, Park Lane Shopper's Boulevard, Kowloon Islamic Center, Hong Kong Heritage Discovery Center, Avenue of Stars, Hong Kong Museum of Arts, Hong Kong Space Museum, Hong Kong Cultural Center, Clock Tower, 1881 Heritage, Harbour City, and Canton Road/ Peking Road. Those buildings and areas are having significant character as well as uniqueness architecture.

As a part of urban areas in Hong Kong, Kowloon has a main station known as Kowloon Station. This main station has connected to the other side of Hong Kong island and to the airport. This main station has been planned and designed significantly as a transit point for all public transport in Hong Kong including MTR, buses, and trams. Kowloon area is not only for transit point, but also has been planned and designed with a Transit Oriented Development concept which provide mixed-use buildings within the area. The buildings consist residential as well as commercial function. The residential function has accomodated not just for all population in Kowloon district, but also including immigrant and tourists. The commercial function within the area have been provided to accommodate the need of the local community as well as the visitors (immigrant and tourists).

The area of Kowloon has been planned and designed as compact as possible to accommodate all the need of the community. The accesses for pedestrian and bikers have been provided along the street in Kowloon District. Figure 2 and 3 show the pedestrian lines and bicycle lines within Kowloon District. Almost all primary street particularly at Nathan Road, has provided pedestrian ways and bicycle ways. Both facilties are to fulfill the basic principle of Transit Oriented Development concept walking and cycling.

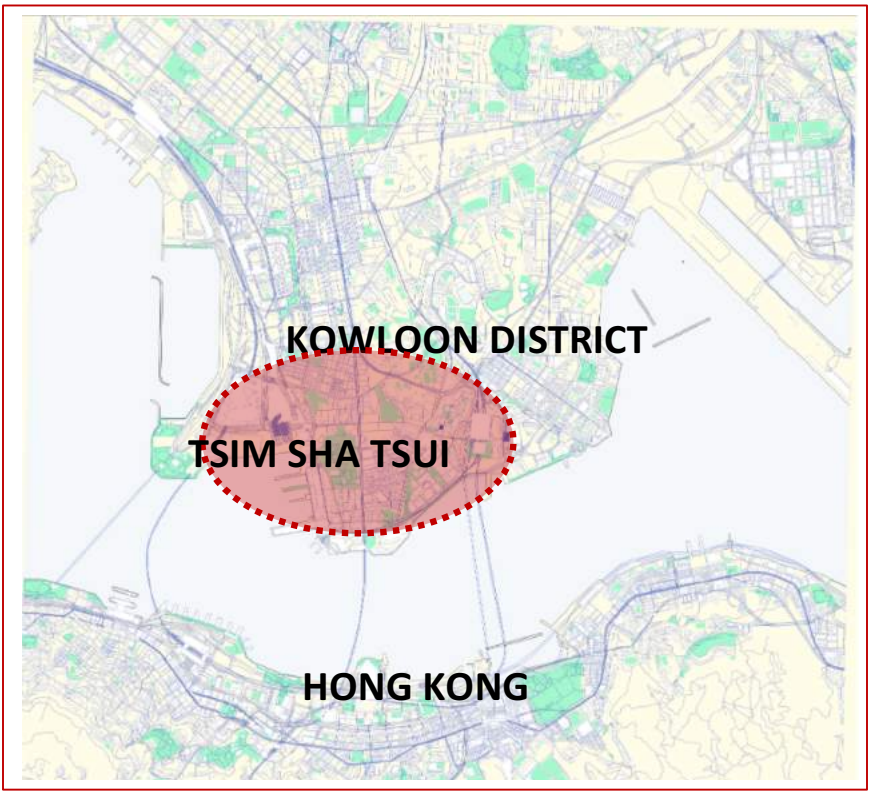

Figure 1: Kowloon District as a part of Hong Kong
Source: Private Documentation, 2019

By providing the facility of pedestrian ways and bicycle ways for all resident within the area as well as visitors (immigrants or tourists), all people have been encouraged to do walking or cycling. This condition will make the concept of Transit Oriented Development succeeded.

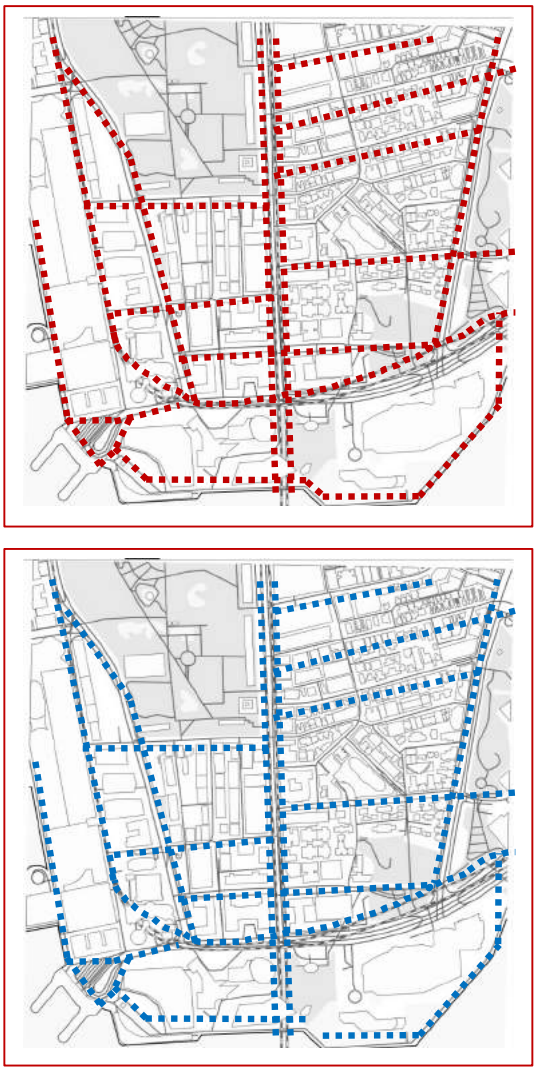

Figure 2 and 3: Pedestrian way and bicycle way in the Kowloon District, Hongkong

To make the implementation of the concept of Transit Oriented Development succeed, the urban planner should provide an excellent plan for the area.

Two other basic principles of Transit Oriented Development are connecting and transitting. To encourage people in making the concept succeed, there should be a facility which connecting from one facility to another one as well as from one function to another one. Within an area which implement the concept of Transit Oriented Development, a network of road, street, path, and pedestrian way should be connected one to another. This network will connect from one function (commercial function) to another function (residential function or recreation function). Although, this area also should provide a transportation system which could connect this district to another district easily, comfort and safe. Moreover, to fulfill this idea, there should be a transit system within the area, thus the function of transitting could be delivered completely.

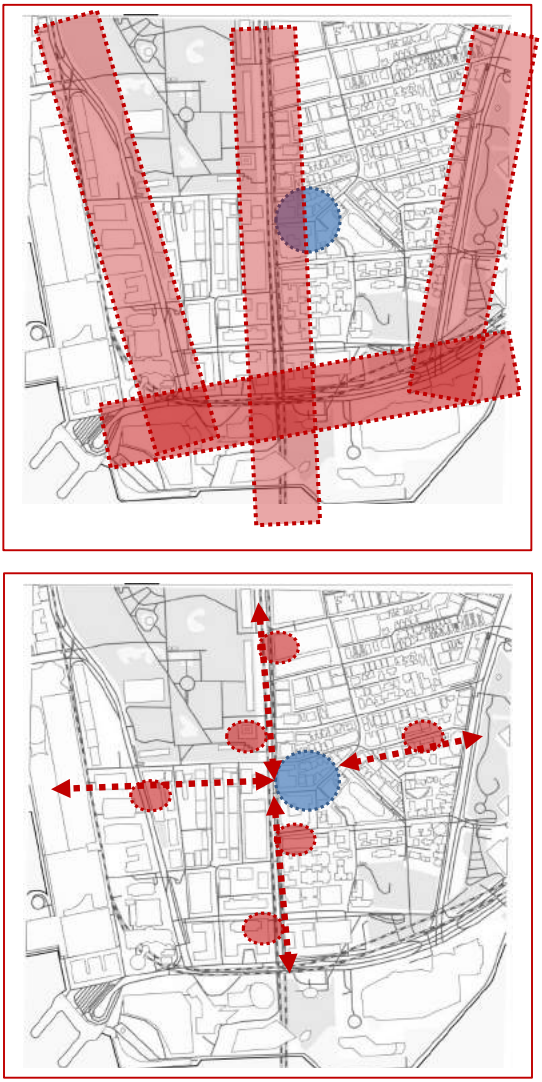

Figure 4 and 5: The principle of TOD for connecting and transitting

Figure 4 and 5 show how Kowloon District in Hong Kong has a connecting facility to relate one function to another within the area. Also, there is a transitting facility which has been provided as a MRT Station (Kowloon Station). This transportation system will transit all the people from Kowloon District to another district in Hong Kong easily, comfort and safe.

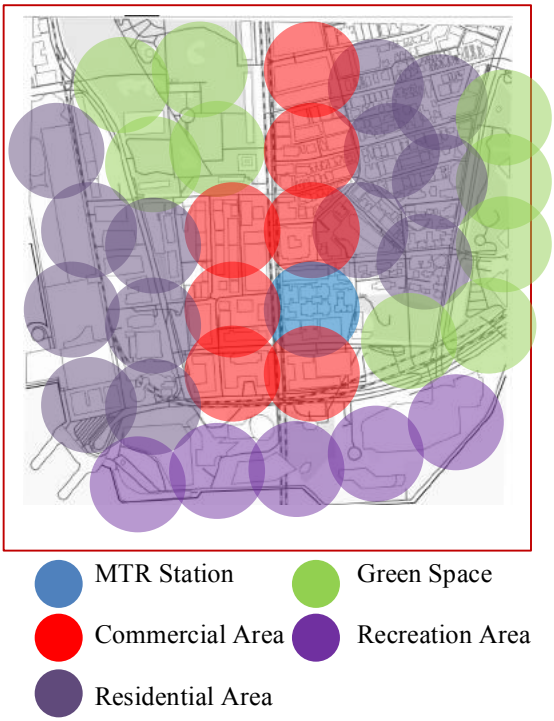

Figure 6: Various function and activities within district are mixing

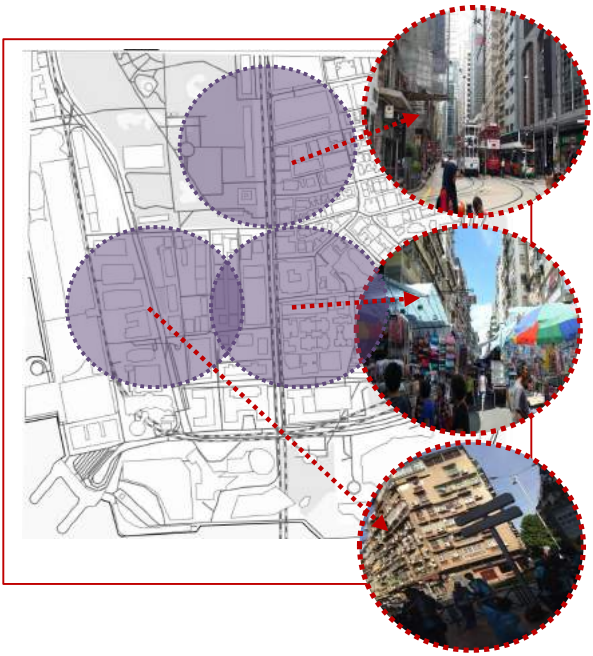

Figure 7: Various function and activities within district are densifying the area

Figure 6 shows the various function and activities within Kowloon District. The differences of function and activities have been shown with colours. Red colour shows the commercial areas within Kowloon District which have been provided along the Nathan Road. Residential areas have been shown by brown colour which are located behind the commercial areas as well as upper the commercial areas. This is because some of the buildings within Kowloon District are mixed-use which consist commercial activities and residential activities. In the middle of Kowloon District, there is a central spot of transit facility which is known as

Kowloon Station of MTR Station, which is shown by blue colour. And finally, the last function and activity is a recreation activity, which is shown in purple colour. This area consists some museums and pedestrian for visitors. This area is well known as a park along the water area named Avenue of Stars.

To make an excellent plan and design for Kowloon District, the urban planner has provided a mixed-use building to accommodate the population of Kowloon which has been regarded relatively high density. This condition has encouraged the urban planner to deliver a concept which implemented in densifying the area become livable for all people. To fulfil this condition, some of the residential building has been designed vertically as an apartment or condominium.

Figure 7 shows how the buildings within Kowloon District have been designed to densify the need of the area.

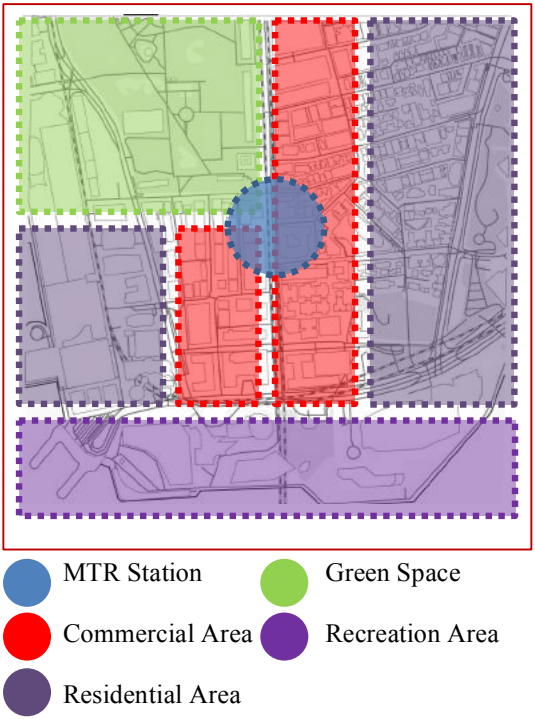

Figure 8: the basic concept of compacting in Kowloon District

The two last basic principle of the concept of Transit Oriented Development are compacting and shifting. Figure 8 shows how the Kowloon District as compact as it is, all the functions and activities within the area have supported and related each other. People could reach everything their need in one area from residential, commercial, recreation even the transportation system which could transport and deliver them to another place from

Kowloon Station. From the first basic principle to the seventh basic principle, it could be concluded that all the basil principles could be completely fulfilled when all the people could shift their routinity and activity by using public transportation such as MTR, Tram or even by walking distance using pedestrian ways within Kowloon District (see Figure 9).

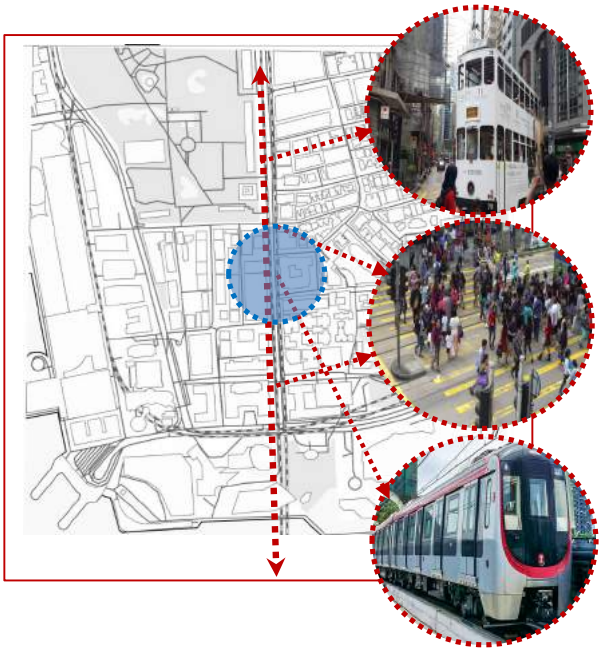

Figure 9: the basic concept of shifting in Kowloon District

Istanbul Historical Area of Turkey

Istanbul which has been known formely as constantinople, is a city with a historical character. Istanbul is a city with a strategic location in Euroasia, because the city has been separated with Bosporus Strait between Asia and Europe. The Europe side consists the historical sites an commercial center which have been known very well by tourists. And the Asia side is a suburban area which is about 30 % of the population live in this area.

The population of Istanbul is not as large as Hong Kong, but in Europe, the population of Istanbul is the fourth largest cities in Europe. There are also many immigrants start to live in Istanbul either to work or to study. The city itself has a unique character particularly in architectural. Many buildings have a historical value either intangible or tangibel values. A lot of tourists came to Istanbul to see the beautiful of the city and the historical behind the city.

One of the historical site in Istanbul is Sultan Ahmet District (see Figure 10). This district consists many historical buildings and the history of Istanbul behind it. Hagia Sophia which used to be Church and transformed to Mosque, Blue Mosque which is located across to Hagia Sophia, Grand Bazaar is a big market in Istanbul, Basillica Cistern which had been used as a water reservoir and many historical building around the district. Those historical buildings are represented the character of Istanbul and the history of the city.

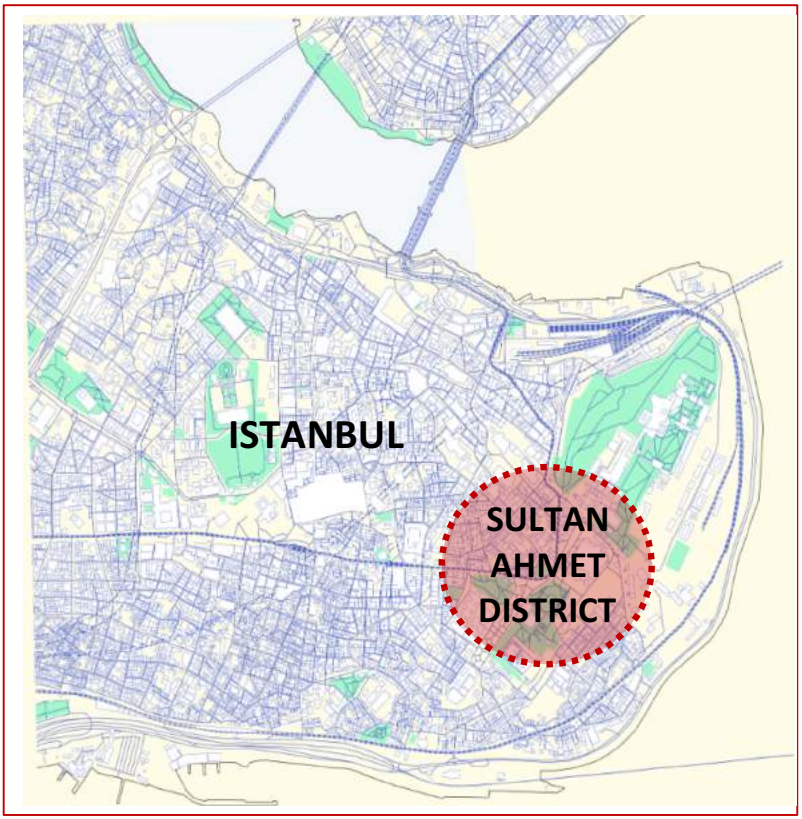

Figure 10: Sultan Ahmet District as a part of Istanbul

To provide comfort and safe for users (local community, immigrants, and tourists), the Local Government as well as the Central Government of Turkey have delivered a concept of good planning within the district. Although, they are never established and mentioned it as a concept of Transit Oriented Development, but when we have explored and analyzed it, the district of Sultan Ahmet could be said implement the concept of Transit Oriented Development.

Figure 11 shows the network of the roads, streets and pedestrian ways within Sultan Ahmet District. All the pedestrian ways follow the network of the roads and streets. All the pedestrian ways have been provided for walkers to mobile and move from one place to another one without any vehicle comforly and safely. Although there is no particular bicycle ways for cyling, all the bikers could use the pedestrian ways to use their bicycles. Figure 12 shows that the bicycles ways also have the same route and network with the pedestrian ways. Using these two concepts of Transit Oriented Development have defined that the district of Sultan Ahmet at least has delivered two basic principles of TOD.

The area of Sultan Ahmet District is very user friendly. All people could just use the public transport to get to the location, and use the pedestrian ways to walk from one historical building to another one, or from one point of interest to another one, as well as from one historical site to another one. The familiar and popular public transport in Istanbul is a tram. This tram could accommodate many people, from their home to their work or from one place to another one. The tram itself also delivers people to the interesting places in Istanbul which have been designated as a historical site or historical district in Istanbul (see Figure 13 and 14). Figure 13 shows how the transportation system in Istanbul which is in this case is a tram. This tram has connected between one district to another one.

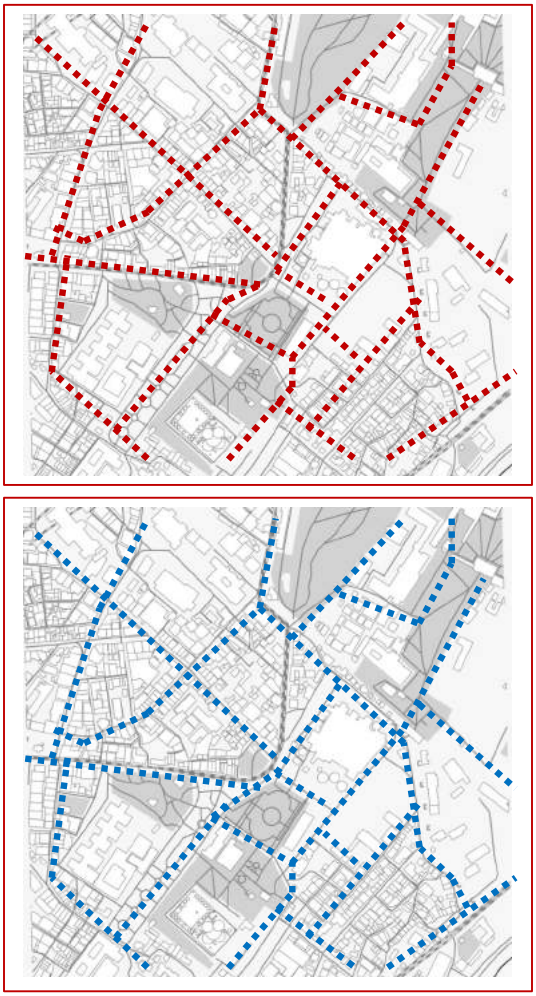

Figure 11 and 12: the basic concept of walking and cycling in Sultan Ahmet District

The station of the tram in Sultan Ahmet District known as Sultan Ahmed Station. From this station, all people could continue their journey by walking distance within the area. This tram station could become a transit point in this area.

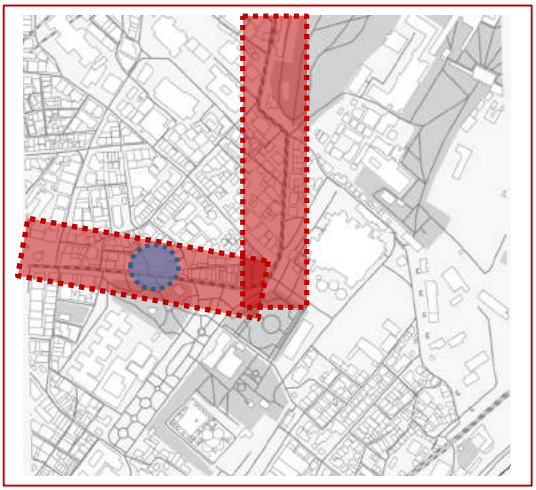

Figure 13: the basic concept of connecting in Sultan Ahmet District

As a diverse city, Istanbul has a unique character in architectural, as well as in Sultan Ahmet District which is very well known as a historical site of Sultan Ahmet. This district has a various zones with many function and activities within it. From commercial, residential and recreation for tourists. Almost all commercial activities in this area have supporting the activities of recreation within the district. Figure 15 shows how the zones within Sultan Ahmet District have various function.

Figure 14: the basic concept of transitting in Sultan Ahmet District

There are at least four functions within this district: commercial area, residential area, green area and recreation area. All the functions are mixing together and accommodate all the need of the local community as well as the visitors.

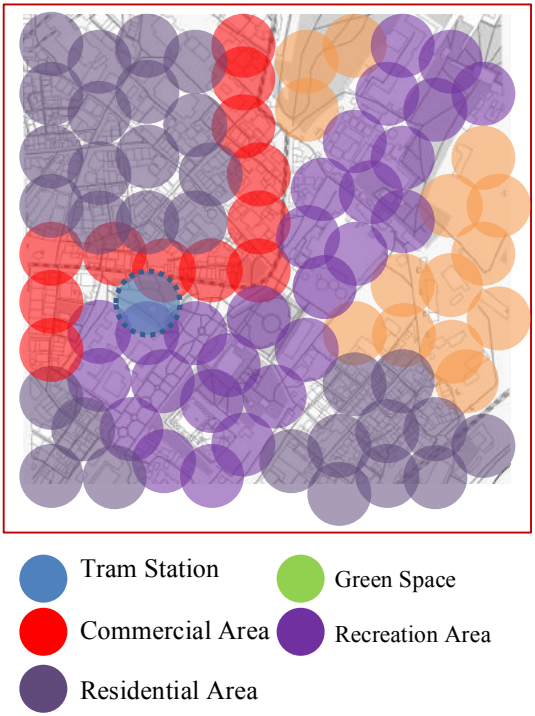

Figure 15: Various function and activities within district are mixing

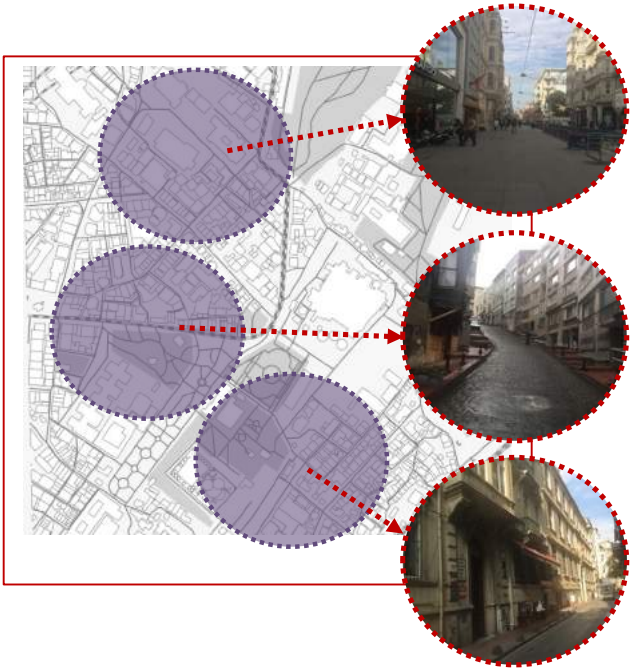

Figure 16: Various function and activities within district are densifying the area

Figure 16 shows some residential buildings in Istanbul particularly within Sultan Ahmet District. Although the population of Istanbul relatively is not as high as Hong Kong, the Local Government is willing to densify the population by accommodate all in the vertical housing. Some of residential building within Sultan Ahmet District are vertical housing for about 3 to 5 floors, it is not as high as vertical housing in Hong Kong.

Figure 17: the basic concept of compacting in Sultan Ahmet District

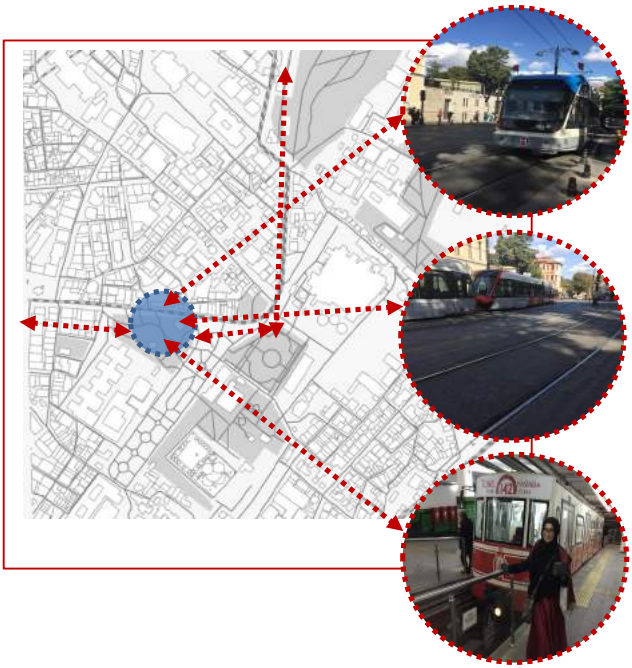

Figure 18: the basic concept of shifting in Sultan Ahmet District

Figure 17 and 18 show how the two las basic principles of the concept Transit Oriented Development has been implemented in Sultan Ahmet District. Although the Local Government of Istanbul is not willing to deliver the concept of Transit Oriented Development intentionally, but from all the analyzes above could describe that the District of Sultan Ahmet which has been known as historical site, could be defined as a district which has implemented the concept of Transit Oriented Development. Although the transportation system which deliver all the

community is not as complex as Hong Kong, but still this transportation of tram has been considered as a system that has adopted a concept of Transit Oriented Development.

CONCLUSION

From the two precedent studies, it could be understood that the concept of Transit Oriented Development could be delivered within metropolitan cities, particularly which have a historical area within it. Kowloon District shows the well-planned of the implementation of Transit Oriented Development with high-complexity of transportation system consists MTR, Tram, and Bus Rapid Transit. On the other hand, Istanbul with a historical area of Sultan Ahmet District shows that the Local Government is willing to plan the area with an excellent design, and as a result it could be defined that the district has implemented the concept of Transit Oriented Development intentionally. Each basic principles of the concept of Transit Oriented Development have been explored and analyzed one by one to see the effectiveness of the implementation of TOD.

To conclude this paper, we can deliver a statement that by implementing a concept of Transit Oriented Development, it could create an integrated area with a specific character which provides accessibility for pedestrians and bikers, transit for public transportation as an effort to enhance the quality of the environment to be more comfortable, safe, attractibe and sustainable.

ACKNOWLEDGMENT

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REFERENCES

[1] Madgin, R. (2013). A Role for Emotional Value and Place Attachment in the Decision-Making Process. How should decisions about heritage be made?. *Arts and Humanities Research Council*. England.

[2] Taki, HM and Maatouk, MMH. (2018). Promoting Transit Oriented Development Typology in the Transportation Planning. *Journal of Communication in Science and Technology*, Volume 3 Number 2, 2018, pp. 64-70.

[3] Purwantiasning, AW. (2017). Understanding the Concept of Transit Oriented Deveopment Through Proposed Project of Manggarai, Jakarta Selatan, Indonesia. *Proceeding of International Seminar and Workshop on Urban Planning and Community Development.* Jakarta, Indonesia. Pp. 63-74.

[4] ITDP. (2017). *Transit Oriented Develpoment Standard 3rd Ed*. Institute Transportation and Development Policy. New York.

[5] Gleave, SD. (2009). *A Guide to Transit Oriented Development (TOD), Draft Final Report, Sacramento Regional Transit*. Sacramento, United State.

[6]Rahmat, A. Endot, IR. Ahmad, Z. Ishak, Z. Ibrahim, CKI. (2016). Development of Transit Oriented Development Model for Malaysia. *Journal of Built Environment, Technology and Engineering,* Volume 1 September 2016.

#05

Understanding the Application of Photovoltaic Technology for Public Transportation

KOLABORASI

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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 have 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

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 innitiatives 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. 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.

WHAT IS PHOTOVOLTAIC TECHNOLOGY?

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].

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].

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).

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.

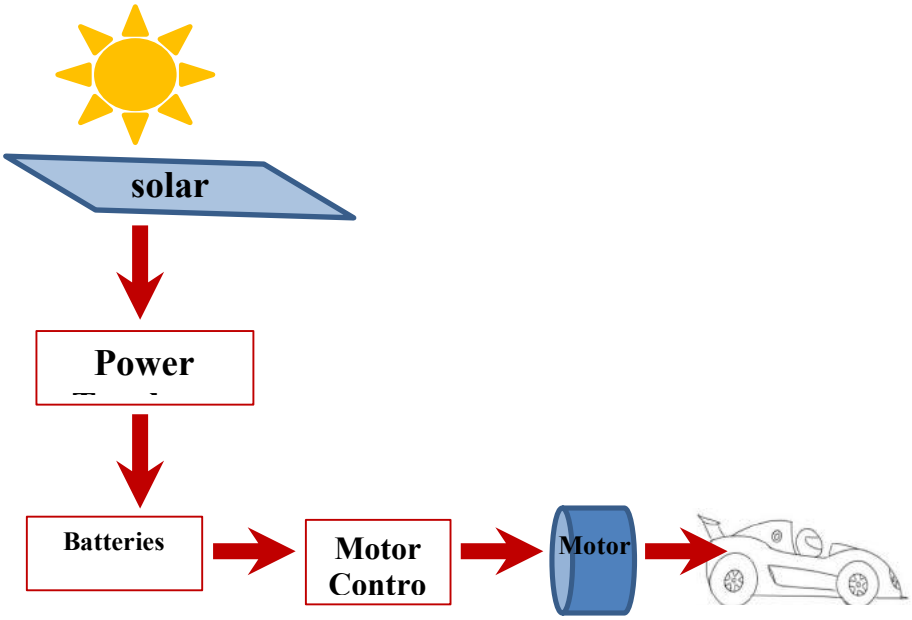


Figure 1: Basic Scheme of Solar Car

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.

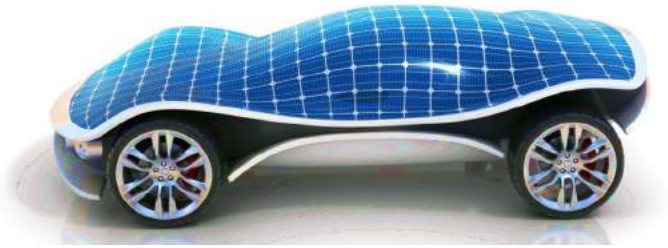


Figure 2: Solar-Powered Car
Source: Izco (2010)

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 have 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 have 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 are

not as comfort as a private vehicle, and this is become an issue that suppose 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 most easiest vehicle that could be reached in all areas or spots. The bus networks usually also the most 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.

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.

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 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.

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 pubic 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.

DISCUSSION OF CASE STUDY

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 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 created 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- Sunda Kelapa to Zone 2-Fatahillah and other zones. This condition has encourage us to do this research and to propose an alternative solution for better quality within Jakarta Old Town.

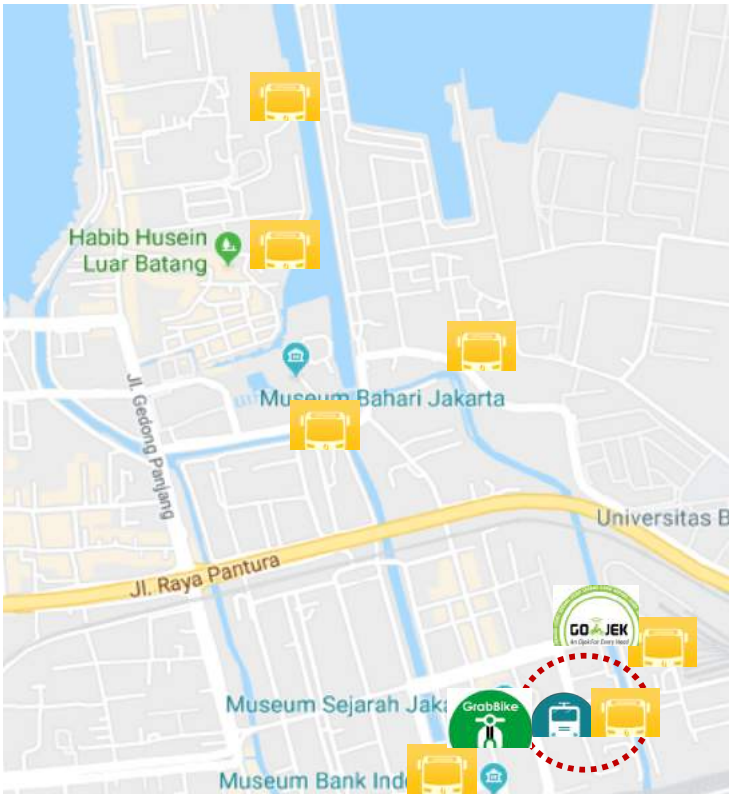
Since that one of the issue within this area is lack of infratsructure and facilties, thus will make visitors uncomfortable, we have done this research and proposed a concept of Transit Oriented Development to be implemented within Jakarta Old Town Area. And to support this proposed concept, we have 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.

Figure 3: Jakarta Old Town
Source: Guidelines of Jakarta Old Town (2007)

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



Bus Rapid Transit/ Trans Jakarta

Commuter Line

Online motorcycle service (Grab and Gojek

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.

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:

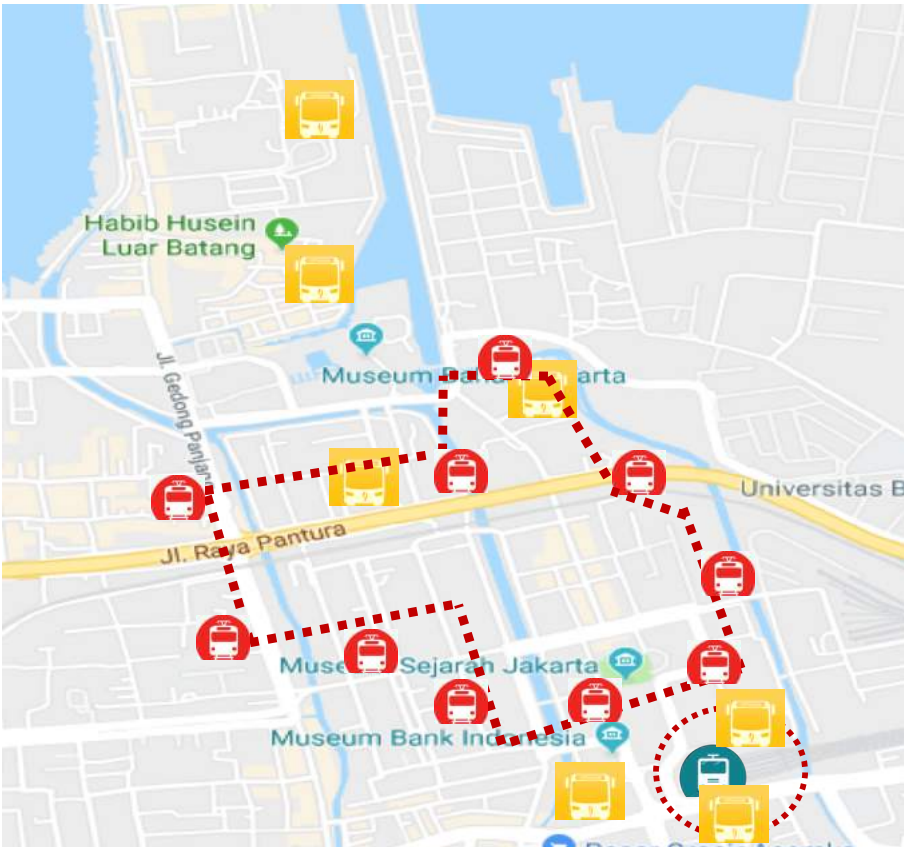
Figure 5: Some historical buildings and point of interest within Jakarta Old Town Area
Source: Guidelines of Jakarta Old Town (2007)

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 from domestic or international. Those historical buildings and sites are located particularly within Zone 1- Sunda Kelapa, 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.

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.



Bus Rapid Transit/ Trans Jakarta

Commuter Line

Tram

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-Sunda Kelapa (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.

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:

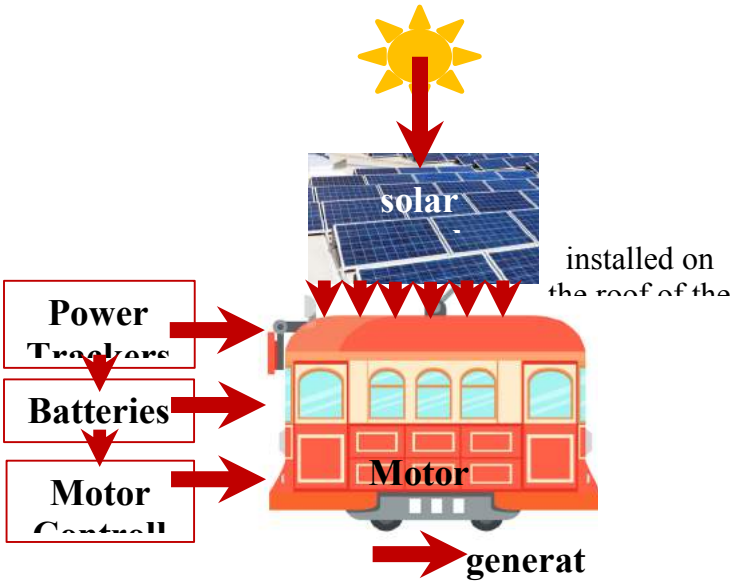


Figure 7: A schematic proposed design for tram system

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 watt 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 Sunda Kelapa: 10 minutes
   g. Frequency from Sunda Kelapa 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.

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.

Giving a calculation of specification and criteria of both need either the tram unit as well as the solar panels, we have concluded that the historical area of Jakarta Old Town could provide some unit of tram within the area to serve the visitors. This idea has been proposed to enhance the quality of the environment as well as the quality of life the local community and visitors. We have proposed the idea of the implementation of photovoltaic technology in public transportation system within historical site of Jakarta Old Town, to support the concept of Transit Oriented Development which will be applied in this site.

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REFERENCES

[1] Güneşer, MT; Erdil, E; Cernat, M and Öztürk, T. (2015). *Improving the Energy Management of a Solar Electric Vehicle.* Advances in Electrical and Computer Engineering. **Volume 15 Number 4, pp. 53-62**.

[2] Bahri, S; Purwantiasning, AW. (2018). *Modern Thought of Photovoltaic Technology in the Implementation of Transit Oriented Development's Concept and Revitalization of Jakarta Old Town.* **Proceeding of International Conference on Civil and Environmental Engineering 2018. UTAR, Kuala Lumpur, 03-05 October 2018**.

[3] Purwantiasning, AW; Bahri, S. (2017). *An Application of Smart Building Concept for Historical Building Using Automatic Control System, Case Study: Fatahillah Museum.* International Journal of Built Environment and Scientific Research. Universitas Muhammadiyah Jakarta. **Volume 1 No. 2 Ed. December 2017.** (2017).

[4] Rizzo, G. (2010). *Automotive Application of Solar Energy*. **Proceeding of 6th IFAC Symposium Advance in Automotic Control, Munich, Jerman. 12th-14th July 2010.**

[5] The Midwest Research Institute. *Basic Photovoltaci Principles and Methods*. (1982). Solar Energy Research Institute. Colorado. United States of America.

[6] Su, Q; Lai, J; Zhang, G; Feng, S; Shi, W. (2010). Flexible Thin Film Solar Cells Using in the Car. World Electric Vehicle Journal, **Volume 4 pp. 793-797**. Shenzhen, Chna.

[7] Izco, FB. (2010). *Fabrication of Solar Panels on the Surface of Solar Car*. Thesis Research Report. Publica Universitas Navarrensis. Spanyol.

[8] Taft, N. (2016). Why Don't We Have Solar-Powered Cars?. Fuel Freedom Foundation. Has been accessed on 10th April 2019. USA.

[9] Purwantiasning, AW; Kurniawan, KR. (2018). The Role of Historical Attachment in the Designation of Conservation Areas in Indonesia in The Post-Colonial Era. International *Journal of Architecture and Urban Studies*. **Volume 3 Number 2 pp. 80-87 March 2018**. Dakam, Istanbul, Turkey.

[10] Purwantiasning, AW. (2013). Designation of Conservation Area as an Effort to Preserve Local Wisdom. *Proceeding of International Seminar on Genius Loci #01*. Universitas Islam Negeri Makassar, Indonesia.

[11] Vajihi, M. (2017). *Solar-Powered Light Rail Vehicle and Tram System*. Sapienza Universita Di Roma. Italy.

[12] Dinas Kebudayaan dan Permuseuman DKI Jakarta. (2007). Guidelines Kota Tua-Guidelines of Jakarta Old Town. DKI

Jakarta. Indonesia.

[13] Purwantiasning, AW; Schneider, V; Whittingham, N. (2015). *Urban Planning Policies and Strategies for Revitalization: An Overview and Comparison of Experiences from Developed and Developing Regions.* Chapter of Revitalizacion de Areas Metropolitanas un Debate Abierto. Instituto de Planeamiento Urbano y Regional, Faculdad de Arquitectura y Urbanismo, Universidad Nacional del Nordeste, Resistencia, Argentina.

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Beberapa tulisan dipublikasikan di suratkabar nasional Kompas dan Tempo serta majalah *lifestyle*. Buku referensi yang dipublikasikan adalah **Sebuah Pemaparan Tentang Penataan Kawasan Secara Partisipatif** (2001), **Komunikasi Arsitektur** (2001), **Konservasi dan Perkembangan Ekonomi** (2004), **Telaah Arsitektur #01** (Maret 2008 dan Februari 2015), **Arsitektur Untuk Rakyat** (Mei 2009), **Warisan Arsitektur Bali dalam Konservasi** (Mei 2014), **Pengantar Ilmu Interior** (Februari 2015), **Telaah Arsitektur #02** (Mei 2015), **Konversi Bangunan Tua Bersejarah** (Juli 2015), **Adaptive Reuse Pada Bangunan Tua Bersejarah: Sebuah Kajian Konservasi Pada Kawasan Kota Lama Jakarta** (Juli 2015), **Kajian Sakralitas Ruang Arsitektur Kampung Naga** (Agustus 2017), **Konstruksi Tahan Gempa Rumah Adat Besemah** (November 2017), **Telaah Arsitektur #03** (Mei 2018), **Telaah Arsitektur #04** (Juni 2018) dan **Telaah Arsitektur #05** (Juni 2019).

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Aktif mengikuti kegiatan pertemuan ilmiah baik berskala nasional maupun internasional dari mulai di Asia, Eropa dan Amerika Latin. Menjadi dosen tamu pada kampus UTN di Resistensia Argentina dan menjadi penasehat pada beberapa masjid di lingkungan Jagakarsa, Ciganjur, Jakarta Selatan.

Beberapa artikel ilmiah dipublikasikan dalam beberapa jurnal baik tingkat nasional maupun internasional baik terindeks maupun tidak terindeks. Beberapa artikel ilmiah dipublikasikan dengan mensinergikan dua bidang ilmu yaitu ilmu rekayasa elektro dengan arsitektur. Beberapa artikel ilmiah merupakan hasil luaran dari hibah penelitian yang diraih melalui kompetisi nasional maupun desentralisasi dengan skim penelitian hibah bersaing, penelitian produk terapan dan penelitian dasar unggulan perguruan tinggi di bawah KEMENRISTEKDIKTI sejak tahun 2012 sampai saat ini.