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# Street network, transportation, and transit oriented development

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**Abstract.** The role of a street is not only related to traffic or physical relations with other street networks, but also related to activities that take place along the street. Street system planning is usually carried out in a highly structured manner based on the street hierarchy. This street hierarchy refers to the amount of traffic available from the large to the small in the environment. Regional planning with the concept of transit oriented development which is one of the urban planning solutions also began to be developed. The concept of development with a structure centered on the transit system has the aim of reducing transportation problems, the function of complex areas and diverse land uses. This paper discusses the street as a urban infrastructure with all its transportation functions juxtaposed with transportation and transit-oriented development.

## 1. Introduction

Street as a land transportation infrastructure covers all parts of the street, including complementary buildings and equipment for traffic. The role of a street is not only related to traffic, physical relations with other street networks, but also related to activities that occur along the street. Street network management is not only about the design and arrangement of street parts to accommodate different users, but is related to the overall structure of the street network including how the streets are interrelated. The street system planning is structured based on the street hierarchy. This street hierarchy refers to the amount of traffic available to the environment. On the other side, planning and developing public transportation is one of the efforts to overcome transportation problems. The addition of the number and type of transportation modes continues. Various transportation network systems are being implemented such as bus rapid transit, light rapid transit, or mass rapid transit. All efforts to develop public transportation are carried out to reduce the number of private vehicles that are increasingly numerous and make congestion in almost all parts of the street. The planning of public transportation systems is different from each other, related to service areas, user carrying capacity, number of modes of transportation and the characteristics of the systems of each of these public transportation. Likewise, pedestrian planning, usually planned with their own desires and goals, such as having to pay attention to pedestrian security, social interaction and also the atmosphere of the street, but sometimes this is not interrelated.

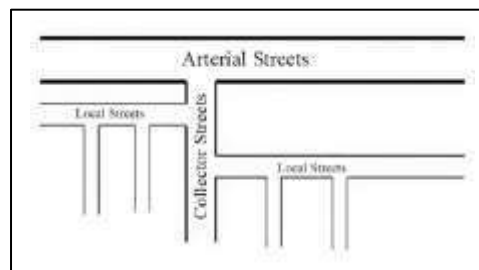


Regional planning with the concept of transit-oriented development as one of the city planning solutions also began to be developed. The concept of development with a structure centered on the transit system aims to reduce transportation problems, function complex areas and diversify land use. Transit-oriented development is an urban development supporting the use of public transportation by focusing the environment on public transport stops, where local facilities and the construction of higher densities are usually placed [1]. The desire to create an atmosphere of walking with various social, cultural, political and economic roles makes the role of the road as a public space. In the end the road is not only used as a transportation route but is also used as a place for people to walk [2].

### 1.1. Street

Street is a land transportation infrastructure in any form that includes all parts of the street including complementary buildings and equipment intended for traffic. Street complement buildings are buildings that cannot be separated from the street such as bridges, overpasses/flyovers, underpasses and others. Whereas street equipment included signs, road markings, traffic safety fences, area owned by the road fences and so on [3]. Role-based street classification, which divides street sections according to their role in the primary system street network system is : [4],

- Primary Arterial Street. It is a street that connects the first level city with the other side-by-side city side by side, and the street that connects the first level city with the second level city.
- Primary Collector Street. Is a street linking the second level of the city with the second level city and the second level city with the third level city under its influence.
- Primary Local Street. Is a street that connects the city to the third level with the other third level city, the first level city with the parcel, the second level city with parcels and the street that connects the third level city with the lower level city until the parcel.



**Figure 1.** Street Hierarchy Based On The Role

The street network consists of street that connect to each other at the meeting point which are transportation nodes that can provide alternative options for street users. System based street network (connecting service) as shown in the street hierarchy figure based on the role, divided into [4]:

- The Primary Street Network System is a street network system that connects cities / regions at the national level.
- Secondary Street Network System is a street network system that connects zones, regions (vertices within the city).

Based on its role, the street network can be divided into [4]:

- Arterial Streets are street that serve long-distance transportation at high average speeds and the number of access street is limited efficiently
- Collector Streets is a street that serves medium distance transportation with medium average speed and the number of access street is still limited

- Local Streets are street that serve short distance transportation (local transport) with low average speed and unlimited number of access streets.

In fact, this functional street classification system considers streets to be transportation corridors for motorized vehicles and urban multi-modal transportation corridors, serving more functions than mobility and access. Other facts are public streets, used as a place to gather, socialize, performance show and more [5].

Integrated urban street systems are often also constrained by the location of various modes of transportation. The street system is based on the street hierarchy and the transportation network is planned at the level of the servants themselves [5][6][7][8].

## 2. Transportation

An integrated urban public transport system is the concept of connecting all types of public transportation in a single system with the aim of achieving efficient transfer times to modes of transportation, reducing density at one transit point, and maximizing travel time. As for some modes of transportation that can be integrated and integrated are city transportation, regular buses, bus rapid transit, trains, light rapid transit, and mass rapid transit.

As one of the main factors in transportation, travel time is a major attraction in the choice of transportation mode that will be used by a trip (human or goods). Increasing travel time on a mode of transportation will reduce the amount of use of the mode of transportation. The effect of increasing the travel time by this user is the transfer of users to other alternative transportation modes. Another factor in transportation is transit costs (freight or passenger transfer fees). An integrated financing system in an intermodal transportation system must be implemented. Planning for effective means of transportation must also be considered.

A sustainable transportation plan is a strategic plan designed to meet the mobility needs of people and businesses in the city and its environment for a better quality of life. This builds on existing planning practices and considers the considerations of integration, participation and evaluation principles. According to the transportation pyramid, cities must prioritize cycling and run first, because they are the healthiest, most space-efficient and energy-efficient modes of transportation. Because the next priority is public transportation. Between public transportation and the use of private cars, we find the use of shared cars such as taxis, car sharing, and sharing trips.



**Figure 2.** Pyramid Of Street User  
(Source : [www.infodiagram.com](http://www.infodiagram.com), 2018)

This concept description can understand that the most basic mode of transportation is and must be above the inverted triangle, which represents which mode should be prioritized above the others. In terms of priority and sharing modes, walking is the most dominant when everything moves and it is appropriate that facilities be provided for everyone to be able to walk safely and efficiently. These facilities include sidewalks, overpasses and underpasses that will drive over other modes (especially motorized ones). Walking is the fairest and most sustainable mode of transportation and is definitely the healthiest. Existing modes of transportation are not the same as each other, whether the dimensions of transportation mode, passenger capacity, or number. Various types of transportation

modes can be connected to each other to form an integrated transportation system. Different modes of transportation also have different degrees of access. Public transportation usually has the greatest access distance, while pedestrians have the lowest access distance. Access distance will depend on the location and condition of the area.

The key success of transit oriented development is starting with the plan and design of the transit area, in this case the station. This review that many stations are surrounded by parking lots, little access to the station, no area that has the potential to be developed around the station, and lack of orderliness of roads for pedestrians to other function areas [9].

### 3. Transit Oriented Development

The concept of urban development predicted (smart growth) is to develop the concept of mixed land use, vertical housing and plan pedestrian-friendly areas. Composite housing will create a high density area, planned at the right location with a distance of facilities and economic services that are affordable by foot or by non-motorized vehicles, so this concept will be able to reduce the needs of private vehicles, save transportation costs, save fuel use, decrease in traffic density, reduce pollution, and improve environmental quality [10][11].

The concept of Transit Oriented Development is defined as a pattern of development that maximizes the benefits of the public transport system, also expressly restores the focus of development to its users – humans. Transit Oriented Development implies a high-quality planning and design process of spatial and regional patterns to support, facilitate, and prioritize not only the use of public transport, but also the most basic modes of transportation, namely walking and cycling [12]. Transit Oriented Development has the following objectives :

- Increase the use of mass transportation services organized by the city government.
- Reducing the use of private vehicles within the Transit Oriented Development area.
- Replacing the mobility of urban citizens into sustainable transportation such as walking, cycling and public transportation.
- Optimizing the function of urban space cultivation to support the growing growth of urban life.



**Figure 3.** Transit Oriented Development Concept  
(Source : www.itdp.org, 2018)

The concept of Transit Oriented Development has evolved since the beginning of the 20th century with the main feature as the development of areas that have a structure centered on transit facilities (mass public transportation) by building various land use functions near the train and bus transit system stations. The Transit Oriented Development concept aims to reduce transportation problems and improve the environment. On the other hand, the development of mixed-use areas is expected to increase the accessibility of the area and reduce travel needs which ultimately reduce environmental impacts and provide alternative solutions to avoid traffic congestion. The development

of the Transit Oriented Development concept is expected to make transit more effective and efficient. This is supported by an integrated intermodal switching system. The existence of an efficient and effective transit system, as well as an increase in public access to various land use functions.

The city of Curitiba Brazil is a city that has successfully implemented the concept of transit-oriented development. The main street in Curitiba is designed to facilitate accessibility of pedestrians. The focus of development is on public transportation infrastructure by designing compact urban space structures so that public transportation is integrated with existing land use at each transit point [13].

#### **4. Conclusion : Street, Transportation, and Transit Oriented Development**

The classification system and alternative street hierarchy are the initial steps in revising the urban transportation system, where street networks accommodate the functions of street use and are integrated with street users (pedestrians).

Transit oriented development areas are very closely related to transportation. The basis of the means of transit as a reference is the existence of transport modes that carry many passengers (train/mass rapid transit). Coupled with the existence of other transportation networks such as bus rapid transit, making the integration between modes of transportation very relevant. The concept of Transit oriented development that promotes pedestrian access or cycling, demands a reduction in private vehicles and demands a lot of public transportation. Street that used to focus more on vehicle traffic, now must also pay attention to the diversity of users and pedestrians. The aim is that this transit-oriented development area can synergize with transportation and street networks, which have several characteristics such as :

- Public transportation must ensure that the public is connected to the transportation network.
- Between modes of transportation must be interconnected, so there is no need to use private vehicles to change the mode of transportation or at a minimum, just by foot.
- Public transport routes directly interact with roads used by pedestrians (passengers).
- Streets that combine vehicle and pedestrian use must all be connected, so there are no separate urban road parts.

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