Effect of high rise building against transportation in campus area

S H Djoeffan*, H Burhanidin and W Weishaguna

Regional and City Planning Study Program, Faculty of Engineering, Universitas Islam Bandung, Bandung, Indonesia

* srihidayatil106@gmail.com

Abstract. Jatinangor is located on the main regional road Bandung – Sumedang. The area which started as a rural area has been transformed to education function. The rapid growth in the region has implications for changes in land use, population increase and various socio-economic activities and most importantly has attracted various investors to conduct high rise building development to accommodate students who are educating in the education area. The emergence of various activities has resulted in increased generation and traffic volume that can cause congestion, increasing fuel consumption, reduced comfort, accidents and air, soil and water pollution which endanger human health in general, animals and plants. Data retrieval using Traffic Counting Method (TC) to identify traffic volumes which is then analyzed by measuring the level of road service based on the calculation by comparing road capacity and traffic volume. The purpose of this study is to find out the level of service road and propose alternative solutions to transportation problems on the Jatinangor highway.

1. Introduction
The problems faced by major cities in the world are not only limited to the mass of land and various types of social problems with various forms, including transportation problems [1]. The increasing number of people in the city which has implications for vertical settlement development has also had an impact on the size of the city which directly with increasing socio-economic activities has triggered the flow of passengers and goods accommodated in various forms and types of vehicles. The increase in traffic volume originating from the flow of goods and passengers that is not in accordance with road capacity has caused the emergence of traffic congestion problems. Traffic congestion occurs in many cities such as Jakarta, Bandung, New York, Bangkok, Beijing, Moscow, Bangkok, Venezuela, Mumbai, Osaka and others [2]. Rapid population growth, especially the student population in the research area in the education city of Jatinangor has resulted in various problems which include: (a) changes in the movement that leads to traffic congestion, (b) changes in the function of the shoulder of the road to parking and street vendors. (c) Do not have proper traffic signs such as angkot shelters, zebra crossing, lighting lamps. Based on the above background, the problem of this research is formulated as follows: (a). In connection with the development of the High Rise Building (HRB), what is the projection of the transportation and environmental conditions in the future Jatinangor education area and (b). how can alternative transportation on the Jatinangor highway be better.

As for the benefits that can be taken in the framework of this research are as follows: (a). Contribute to the regional government to control the construction of city roads that are more, safe, comfortable and
healthy and (b). To contribute to the local government regarding essential matters for the evaluation of the Jatinangor Spatial Detail Plan especially in the aspect of transportation.

![Congestion in Jatinangor area](image)

**Figure 1.** Congestion in Jatinangor area.

2. **Literature review**

2.1. **The essence of transportation**
Transportation is an integral part of community function, which shows a very close relationship with modern civilization, lifestyle, air pollution, accidents, land use and changes in the structure of space including the needs of road bodies, terminals, garages, parking lots, workshops, assembly industries, container [3]. Where in Los Angeles and New York land use for transportation covers 25 to 30% [3]. In developing countries transportation problems are closely related to the priorities of economic and social development of a city and region. In urban areas, transportation programs are closely linked to urban development plans, especially in the development of residential settlements, workplaces, shopping and entertainment [3].

2.2. **Relationship between land use and transportation systems**
Transportation is not the final destination, but is a derivative of demand (derivative demand). Transportation is always associated with the purpose of transportation, for example, traveling from home to office, to the trade center, to recreational places or transportation to transport goods from the industry to the port, to shops etc. This means that the further the location of activities with other activities, the longer the transportation must be carried out.

2.3. **Linkage of transportation with building arrangements**
Phenomena that occur especially in cities that are developing are high-rise buildings. The HRB that have exploited the land have raised a variety of problems that are quite complex such as increasing traffic.
generation as a result of changes in land use. These conditions, if not accompanied by adequate road construction and parking facilities as well as open space design, will cause traffic congestion which will have an impact on increased fuel consumption, reduced comfort, accidents, and air pollution [4]. Besides that, it also causes the impact of air pollution, solid waste generation, decreasing surface water, traffic problems, water, and soil pollution, which endanger human health in general, animals, and plants [5].

High buildings will change the direction of the wind directly to a solid building as a source of pollution, increasing CO₂ concentration will also cause an increase in wind speed [5]. The form of urban planning and design since 1970 has shown the adoption of the concept of building forms that focus on the environment [6].

Construction of high-rise buildings and changes in land function will have a positive effect through market mechanisms related to increasing land prices and creating economic / welfare and social diversification and environmental balance [7]. The optimal use of many-store buildings in addition will cause building density also directly, will also foster social welfare and as a positive effect acceleration on sustainable urban development [8].

3. Method
The scope of the research area includes the Jatinangor highway corridor which starts from the toll road junction to the Jatinangor highway to the 3.5 km Congeang river. In this corridor, there is an agglomeration of educational campuses, IPDN, Unpad, ITB, Kopertis office, and several potential development buildings for the High Rise Building (HRB) such as Easton Park, Sky, Melati, Pine Wood.

Data collection that include primary and secondary data. Primary data is obtained from traffic counting study and secondary data sourced from literature consisting of various policies and profiles of high rise building areas. Traffic Counting Method (TC) to identify traffic volumes in the main corridors of the Jatinangor region.

In addition, there will also be a primary and secondary survey conducted in the field related to various legal bases and the regulations in the planning area Bandung Raya Spatial Plan area profile of culture of community. The output of this data is in the form of tabulation of the number of vehicles in Table 1.

| No | Formula | No | Formula |
|----|---------|----|---------|
| 1 | Vehicle Volume | 4 | Vehicle Speed |
| | Q = n / T | | V = L / T. |
| | Q = Traffic volume that passes through a point | | V = Vehicle speed (km / hour) |
| | n = number of vehicles passing the point in time interval T | | L = Segment length (km) |
| | T = time interval of observation | | T = Average travel time along segments (hours) |
| 2 | Vehicle Volume | 5 | Road Service Level |
| | Q = n / T | | Tp = Q / C, |
| | Q = Traffic volume that passes through a point | | Tp = level of road service; |
| | n = number of vehicles passing the point in time interval T | | Q = Traffic volume (vehicle / hour) |
| | T = time interval of observation | | C = Road capacity |
| 3 | Road Capacity | 6 | Vehicle Speed (Plans) |
| | C = C₀ x FCw x FCsp x FCsf | | FV = (FV₀ + FVw) x FFVSF x FFVCS (Km / hour) |
| | C = actual capacity (pcu / hour) | | Where: FV = Speed of free flow of vehicles (km / hour) |
| | C₀ = Basic capacity (pcu / hour) | | FV₀ = Basic free flow rate (km / h) |
| | FCw = Road width adjustment factor | | FVw = Adjustment of effective traffic width (km / hour) |
| | FCsp = Direction factor (only for undivided road) | | FFVSF = Adjustment of side barriers conditions |
| | FCsf = Side friction and shoulder / curb adjustment factor | | FFVCS = Adjustment of city size |

TC time is done at each peak times, because of differences in traffic characteristics at each peak time. Peak time is limited to weekly peak times and daily peak times. Weekly peak time is divided into two.
peak times, namely weekdays (Monday - Friday), Saturday and Sunday. While the daily peak time is divided into four peaks, namely: morning (7:00 a.m. - 09:00 p.m.), afternoon (11.00 p.m. - 13:00 p.m.), afternoon (16.00-18.00 p.m.), and evening (20.00-22.00 p.m.)

Some analytical methods that will be used in the completion of this study include (a). Calculate the number of traffic generation that will be caused due to the construction of residential areas with many floors; (b). Identify the characteristics of traffic on the Jatinangor Highway Section, including: Traffic volume, vehicle speed, capacity and assessment of road service levels and (c). Analyze the level of road service. The analysis includes various calculations as shown in the table above.

4. Results and discussion
The city of Jatinangor has a strategic position located on the toll road linking Cileunyi - Sumedang - Dawuan (Sumedang toll road: Preparation of Tatralok District, Sumedang, V-9) which will be connected to the Kertajati international airport. This city functions as a center for the development of human resources which functioned as an education city (Sumedang Regency Government: Preparation of Tatralok District of Sumedang, V-6). The development of this function has attracted various investors to build high rise building along the study area. This research covers there are 4 (four) locations for the construction of high-rise houses with the condition of 2 (two) buildings already operating and 2 more are already in the finishing stage of construction. The total area of land owned by the 4 developers reached 7.86 hectares including the planned construction of 12 towers with a total of 83 floors and 3,815 units.

By operating the four buildings, the apartment will have an impact on traffic problems.

Table 2. Development of high rise building in Jatinangor area.

| No | Name of HRB     | Building Plan | Floor Number | Size  | Number of Units |
|----|-----------------|----------------|--------------|-------|-----------------|
| 1  | PineWood        | 4 tower        | 20           | 3000 m² | 755             |
| 2  | Easton park     | 3 tower        | 23           | 5600 m² | 1535            |
| 3  | TamanMelati     | 1 tower        | 20           | 2.5 ha  | 775             |
| 4  | Sky             | 4 Tower        | 20           | 4.5 ha  | 750             |

Source: Agencies Survey

Table 3. Level of service [9].

| Level of service | Level of service characteristics                                                                 | Scope of Limit Q/C |
|------------------|-----------------------------------------------------------------------------------------------|-------------------|
| A                | Free flow conditions at high speed, the driver can choose the desired speed without obstacles  | 0.00 – 0.20       |
|                  | The current is stable, but the operating speed is limited by traffic conditions. Drivers have  |                   |
|                  | enough freedom to choose speed                                                                 |                   |
| B                | The current is stable, but the speed and motion of the vehicle are controlled. Drivers are     | 0.20 – 0.44       |
|                  | limited in choosing speed.                                                                     |                   |
| C                | The current is near unstable, speed can still be tolerated                                      | 0.45 – 0.74       |
| D                | Traffic volume is near / at capacity. The current is unstable, speed sometimes stops          | 0.75 – 0.84       |
| E                | Forced or jammed currents, low speed, volume above capacity. Long queues and big obstacles     | 0.85 – 1.00       |
| F                |                                                                                               | > 1.00            |
5. Conclusion and suggestion

5.1. Conclusion
Based on service level calculations and guidelines conclusions are as follows:

Traffic flow in the research corridor was 65% in a state of instability, namely the level of service, D, E and F. In this condition the current that is initially near unstable causes the speed to decrease, sometimes to stop. This low speed causes a long queue until a large obstacle occurs.

The corridor of this road shows 64% of the characteristics at the service level B and C where the current is stable, but the speed and motion of the vehicle is controlled. Drivers are limited in choosing speed. This level of service occurs almost every day, especially between 6am and 9am where there is movement of people towards the campus, industries around Ujungberung and commercial activities that are developed on the ribbon development along the road corridor. In the afternoon when lunch and evening when the campus disbanded and industrial workers come out / go home Time of observation between 11:00 and 19:00 due to the occurrence of coal, heavy equipment and material flow from the direction of Sumedang city towards the industry around Ujungberung and Bandung, the level of service D indicated by the current is unstable, and the speed is still tolerated to occur on Monday to Thursday.

From the results of the calculation after the construction and operation of the apartments will tend to increase the traffic volume of 763 SMP which is from 20% of the number of rooms in each apartment built. This will tend to make the level of road service decrease as a whole, to the level of service F (Q / C > 1) which has the characteristics of traffic jam, low speed, volume above capacity. Long queues will occur with great obstacles. This will reflect the bad conditions of traffic along the Jatinangor highway.

At present there has been an average slowdown in vehicle speed from 55.00 km / h to 18.59 km / hour or a slowdown of 34% from the planned speed. This is related to the calculation of the service level above. The slowdown in speed can result in various measurable and unmeasured losses. Measurable include increasing vehicle operating costs in the form of wasteful use of fuel and wear of vehicles. Which are not measurable include air pollution, stress as a psychological impact.

5.2. Suggestion
Based on the conclusions above, the handling recommendations are as follows:

To build a new local road that are served by local transport behind the education area that connects IPDN, IKOPIN, ITB and UNPAD campuses as an effort to unravel congestion.

Opened 2 access roads to Ujungberung area besides Jalan Kol. Ahmad Syam namely Sukawening and Caringin roads as one of the alternative congestion breakers which will tend to be at the F service level. This happened apart from the emergence of the four apartments also by the tendency of increasing student homecoming on Saturdays and Sundays in addition to the increasing flow of regional scale goods connecting Bandung - Cirebon via Sumedang. The last two roads, the Sukawening road and the Caringin road can be done by widening the road from 2, 5 meters (existing) to 7 meters. Feeder Road plans are as follows in figure 2.
Figure 2. Feeder road plans.

References
[1] Warpani S 1990 Merencanakan sistem perangkutan (Bandung: ITB)
[2] Aswari 2013 Singapore Traffic Congestion Solution: Pricing Pricing Pricing! [online] retrieved from http://transport policy 2013.blogspot.com/
[3] Morlok E K 1995 Pengantar Teknik dan Perencanaan Transportasi (Jakarta: Erlangga)
[4] Lie Z, Hong J, Arefehnasri, Shen Q 2012 Journal of Transport and Land Use.5(3) 40-52
[5] Hayati H and Sayadi M H 2012 Impact of tall building in environmental pollution, Environmental and Civil Engineering Department, University of Birjand, Birjand Iran, Journal of Environmental Skeptics and Critics 1(1) 8-11
[6] Smith A 2012 Events and Urban Regeneration- The strategic use of events to revitalise cities (London and New York: Routledge)
[7] Lin J and Mele C 2013 The Urban Sociology Reader (London and New York: Routledge) p 51
[8] Geenhuizen M V and Nijkamp P 2012 Creative knowledge cities: myths, visions and realities (Cheltenham, Britania Raya: Edward Elgar Publishing)
[9] Nozick L K and Morlok E K 1997 A model for medium-term operations planning in an intermodal rail-truck service Transportation research part a: policy and practice 31(2) 91-107