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Research of Fly over as a Solution to Congestion of Intersection Junction: Case Study: Jalan Jatingaleh Semarang

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Abstract: In the next few years traffic will happen most of the time. This was triggered by the growing rate of vehicles against the road capacity which is not balance. All the time the congestion in the city of Semarang has occured at peak hours. Congestion also occured in between Teuku Umar and Setia Budi road Jatingaleh because of a plot intersection (Kesatrian intersection, PLN intersection and Jatingaleh intersection) with the Toll Road. Jatingaleh is located in the southern city of Semarang which is a central meeting point between the upper and lower Semarang where the vehicle flows in through a combination of local current and regional traffic, and the flow of vehicles coming in and out from highway. The main cause of the problems that occurred in the area of Jatingaleh is due to the numbers of vehicles movement that occurs at the intersections. With the above issues, it is necessary to analyse the existing conditions and look into some solutions. Before carrying out an analysis a field surveys at peak hours for example morning (06:00 to 08:00 am) and for the afternoon (04:00 to 06:00 pm) should be conducted, then the number of vehicles is counted manually with "short-breakcounting" according to types of vehicles. From the analysis we found that the degree of saturation (DS) is 1.61 between Teuku Umar and Setia Budi road during the morning peak hours and 1.56 during the afternoon peak hours. This means that the capacity of the existing road is no longer able to accommodate the traffic flow. One of the solutions for the congestion that occurs at the intersection of Jatingaleh is to apply the efficiency of the intersection that is not in a plot with a Fly over, Underpass and the combination of Fly Over-Underpass. Base on the flow reduction calculation with 3 comparative modeling it shows that the Fly Over is the most technically efficient to be applied in this research.

Key words: Congestion, intersection, and interchange.

1. Preliminary

1.1 Background of Study

The success of development is strongly influenced by the role of transport as the lifeblood of political, economic, social, cultural, and the defense and security. Development of the transport sector aimed at the realization of a national transportation system that is reliable, highly skilled and organized effectively to support and drive the dynamics of development at the same time, supports the mobility of people, goods and services, supporting national distribution patterns and to support regional development and improvement of international relations will further strengthen the development of life of the nation in order embodiment insight archipelago [1-5].

Embodiment of the national transportation system that is effective and efficient, face a variety of challenges, opportunities and constraints with respect to the change in a dynamic environment such as decentralization, economic globalization, changes in demand behavior of transportation services, political conditions, the development of science and technology, concern for environmental sustainability and resource limitations. In anticipation of these conditions, the transport system needs to be arranged and completed

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with the support of qualified human resources, to realize the reliability of services and inter-and intra-modal integration of transport, in order to meet development needs, the demands of society as well as national and international trade by observing the reliability and feasibility transportation facilities and infrastructure.

The presence of motor vehicles as a means of transportation require highway vehicle as the flow goes both motorcycles, cars, trains and others. The density of population in a city, each of which requires and have a vehicle for transportation heading to work or perform daily activities would require highway vehicles that can accommodate all existing arrangements with traffic management so that each vehicle can run normal and smoothly without congestion, many cities in the country with economic growth increased sharply frequent increase in the number of vehicles with a graph sharp increase while the road infrastructure still requires time and many obstacles to follow the development of the existing number of vehicles so as to serve the maximum, for example in Indonesia particularly in the city of Semarang one of them is the Teuku Umar (Jatingaleh) are identical to congestion at peak hours, this is caused not only by the presence of three (3) plot of intersections that are Kesatrian intersection, Jatingaleh intersection and PLN intersection, but also not the functioning of traffic lights.

In this study, will be discussed with the transport arrangements based traffic management to reduce congestion that occurs especially at peak hours. The results of the analysis and the calculation is expected to be a reference or material to determine strategies and designing flyovers as a solution to the congestion at the existing intersection at Jalan Setia Budi-Jalan Teuku Umar Jatingaleh Semarang

1.2 The Main Problems

The problems occur at Jalan Setia Budi segment Jalan Teuku Umar Semarang is:

1. High density traffic causing congestion so that the user comfort level decreases.

2. There are three intersections which is located adjacent.

1.3 Purpose and Objectives

Purposes and objectives of the study and analysis of the calculations in this study are as follows:

1. To identify existing road conditions including the level of service Jalan Setia Budi-Jalan Teuku Umar Semarang.

2. Obtain the efficiency and performance of fly over the basic design as a solution of congestion.

1.4 The scope of study

The scope of study and analysis of the calculation of the field research was to determine the existing condition which consists of the road and traffic characteristics that occurred in Jalan Setia Budi-Jalan Teuku Umar Semarang and modeling interchange to reduce congestion.

1.5 Boundary Problem

In this study, to reduce the congestion that occurred in Jalan Setia Budi-Jalan Teuku Umar Semarang with modeling of interchange.

2. Bibliography

2.1 The Traffic Behavior

In general, the level of services can be distinguished as in Table 2.1 [6-11]. the following:

2.2 Traffic Conditions

Flow and composition of traffic flows at planning involves determining (km / h) and passenger car equivalences (Emp).

2.3 Side Barriers

The level of side barriers can be seen from table 2.4. below:

Table 2.1 Criteria for level of service.

Level of service	characteristics	degrees of saturation
A	Free flow conditions at high speed, the driver can select the desired speed without resistance	0,00 – 0,20
B	Stable flow, but speeds began to be restricted due to traffic conditions, the driver has sufficient freedom to choose the speed of	0,20 – 0,44
C	Steady flow, but the speed and motion-controlled vehicle, the driver is limited in choosing speed	0,45 – 0,74
D	Approaching unstable flow, the speed is controlled, is still tolerated	0,75 – 0,84
E	The volume of traffic approaching or are at capacity and unstable flow, speed occasionally stop	0,85 – 1,00
F	Currents were inhibited, low speed, the volume under capacity, long queues and barriers occur side	>1,00

Resource: MKJI 1997.

Table 2.3 Emp determination for urban roads and one-way split.

Road type: One-way streets and divided way	Traffic flow per lane (veh / h)	Emp	
		HV	MC
Two lanes one way (2/1) and	0	1,3	0,40
The four-lane divided (4/2 D)	1050	1,2	0,25
Three lanes one way (3/1) and	1	1,3	0,40
Six-lane divided (6/2 D)	≥ 1100	1,2	0,25

Resource: Manual Kapasitas Jalan Indonesia 1997.

Tabel 2.4 Determination of the side barriers for urban roads.

Class Barriers Side	code	Total incidence per 200 m per hour (two-sided)	Specific of Conditions
very low	VL	< 100	Residential areas, roads with road side
low	L	100 – 299	Residential areas, some public transportation, etc.
medium	M	300 – 499	Industrial area, some shops on the side streets
high	H	500 – 899	Commercial areas with high road side activity
very high	VH	> 900	Commercial area with market activity beside the road

Resource: Manual Kapasitas Jalan Indonesia 1997.

Table 2.6 Separation capacity adjustment factor towards urban roads.

separation directions SP % - %		50-50	55-45	60-40	65-35	70-30
FC_{SP}	two-lane 2/2	1,00	0,97	0,94	0,91	0,88
	four-lane 4/2	1,00	0,985	0,97	0,955	0,94

Resource: Manual Kapasitas Jalan Indonesia 1997.

Tabel 2.5 Basic capacity (C_O) urban roads.

Type of Road	Basic capacity (smp / h)	note
Four-lane divided or one-way	1650	Per lane
The four-lane undivided	1500	Per lane
Two-lane undivided	2900	Total two-way

Resource: Manual Kapasitas Jalan Indonesia 1997.

2.4 Capacity

Determination of the capacity adjustment factor for the separation direction as contained in Table 2.6.

2.5 Interchange

Some examples of Interchange can be seen in Figure 2.3.

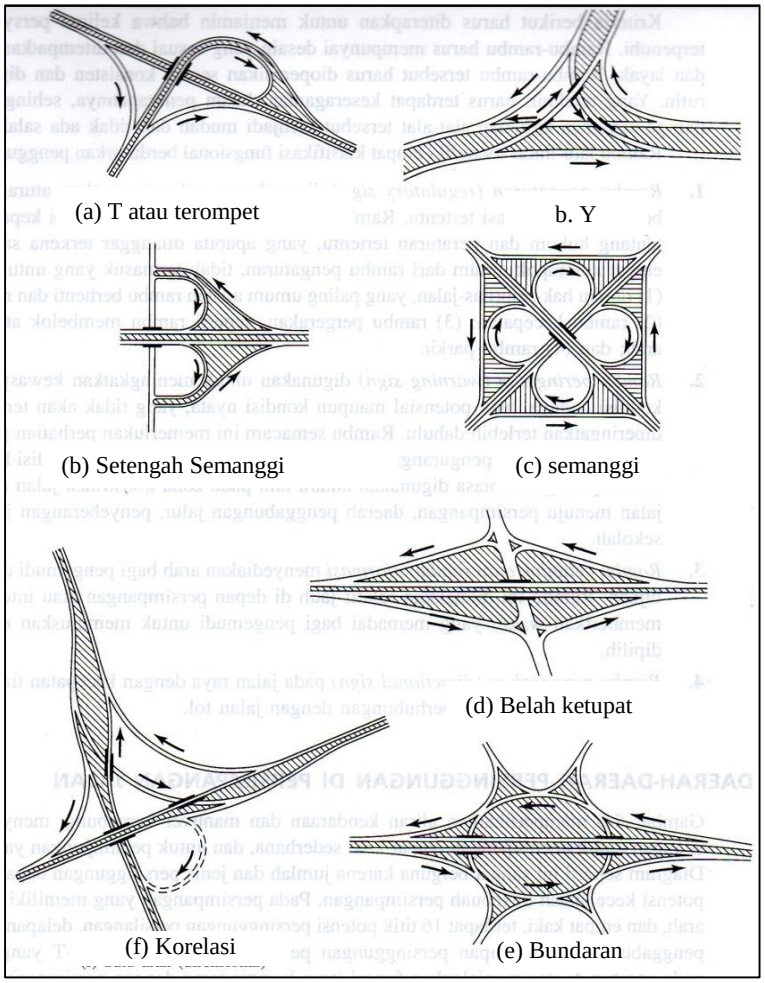

Fig. 2.1 Types of Interchange.
Resource: Khisty, 2002.

3. Research Methodology

3.1 Type of Review

The study used a descriptive quantitative approach is the method of study that sought to describe / explain the situation of traffic conditions as well as a field survey to obtain primary data include the volume roads, road capacity and delays in the research study. The paper is theoretical because the assumptions and logic used to solve a problem that occurs with quantitative models. Conducting a survey of existing data is essential in the scientific method. Obtaining information from previous studies to be done without regard to a review of the use of primary data or secondary data [12-14].

Literature study can be done after determining the problem, so that the study of literature can be used as a reference and support in solving the problem. Analyze the data and the problem should be done diligently is important literary work in doing the study. Further modification and analysis on modeling Fly Over, Underpass, and the incorporation of Fly Over-Underpass adapted to existing conditions.

3.2 Traffic Surveys

The data used in the conduct of the study is primary data and secondary data. Primary data is data obtained from field observations, while secondary data or the data do not directly represent the data the data obtained from the data recorded in the appropriate agencies that support the primary data.

3.3 Primary Data

In this thesis to study the Fly Over as one solution to the congestion persimpang object Jalan Setia Budi study-Jalan Teuku Umar require primary data as follows:

1. Traffic characteristics
2. Side Barrier

3.4 Secondary Data

Basically, the secondary data supporting survey data in the field. Secondary data is derived from statistical data issued by the government or research institutions and also publications or reports related studies pertaining to the object of research studies, such as population data, the data of motor vehicles, as well as non-motorized vehicles.

3.5 Method of Survey

In the preparation of case studies should use appropriate methods to obtain the necessary data in an efficient cost, time and effort. Data collection was carried out as follows :

Observer determines that register all vehicles that pass through the study site.

Each vehicle is recorded on long sheets of arrival and dismissal.

Recording is done to get the number of vehicles per hour.

3.6 Equipment Survey

Survey equipment that will be used are:

a. Stationery (notebooks, ball point, pencil)

b. Measuring tools (ruler, meter rollers, watches, stopwatch, handcounter)

c. Tool documentation (handycam)

d. Other supporting tools (umbrella, clip board)

e. Survey form.

3.7 Implementation Research

In this study the implementation of processes or practices carried out in accordance with the stages of its activities, as for how its implementation is as follows:

3.8 Observation and Research Implementation Time

The data collection of traffic volume or the number of vehicles passing on the line observations done by listing all the vehicles passing through a transverse tread line on the observation post during the time of observation aided by the use of calculators manually using camcorders. From the field survey data obtained by the volume of traffic, travel time, speed, side barriers including public transport stops up and drop off passengers.

As per the results of the analysis of the performance of Jalan-Jalan Teuku Umar Setia Budi (Jatingaleh-Semarang), analysis of barriers aside, the analysis of the level of service and performance, obtained the factors that affect the traffic congestion in the study area is a plot of the distance between the intersection of intersection Kesatrian , PLN intersection, and the intersection Jatingaleh closely spaced, particularly at the intersection of a parcel of residential driveways and motorway exit.

3.8.1 Data Collection

At this stage of data collection both primary data and secondary data. In the field implementation of things that need to be done are as follows:

1. Documentation making the situation of traffic flow at Jalan Setia Budi-Jalan Teuku Umar Semarang
2. Record the amount of traffic volume and density of the road every 5 minutes within 60 minutes.

3.8.2 Data Processing

Processing data in accordance with the method specified quantitative descriptive approach. As for the study are:

1. Direct observations

- The location and the environmental conditions at the junction along Jalan Teuku Umar Semarang Jalan Setia Budi
- The number of vehicles passing through the main road and the minor road (and out of)

2. Bibliography

After data collection is complete and the next stage of data analysis is to identify the appropriate scope of

the study with reference to the literature.

3.8.3 Presentation of Data

Volume is defined as the number of vehicles that pass a point of observation sector in the lane with a certain direction for a certain time interval. Both the average current and volume, here using one hour time interval.

Corresponding volume of vehicle data recording observations, classified by type of vehicle and direction of the vehicle to facilitate in identifying the capacity and level of service at each intersection of Jalan Teuku Umar sepanjangan-Semarang Jalan Setia Budi. At this stage of data analysis as follows:

1. Analysis of the existing condition includes:
- The capacity of the road
- Degree of saturation
- Delay
- Opportunity queue

2. Analysis of the shape of Fly Over, Underpass, and Fly-Over Underpass include:
- Analysis of the capacity of each modeling
- Analysis of the effectiveness of each of the modeling consists of flow reduction / division and reduction in the amount of current flow. In this case comparing the situation before and after the Fly Over, Underpass, and Fly-Over Underpass.

3. Comparative analysis of the percentage of effectiveness of modeling Fly Over, Fly Underpass and Over-Underpass.

4. The Analysis

4.1 Vehicle Type

Type of vehicle consists of LV (Four Wheel Motor Vehicles) in the form of passenger cars, minivans, pick-ups, small truck, jeep, HV (Motor Vehicle More Than Four Wheel) in the form of trucks, buses and MC (Motor Vehicle Wheeled Two or Three) in the form motorcycle. Modes of transportation across the street is very diverse in the form of public transport passengers, public transportation, freight and personal vehicles. This happens because the main function of Jalan Teuku Umar Street Setia Budi is as a liaison between the District District Tembalang-Candisari heading into the city center. As per the results of field observations on the types of vehicles in the morning peak hour (6:00 to 08:00 pm) and afternoon (4:00 p.m. to 18:00 pm) like the diagram below [15-18]:

By looking at the type of vehicle composition diagram in Figure 4.2, the type of vehicle that overload of traffic along Jalan-Jalan Teuku Umar Setia Budi dominated by motorcycles (MC).

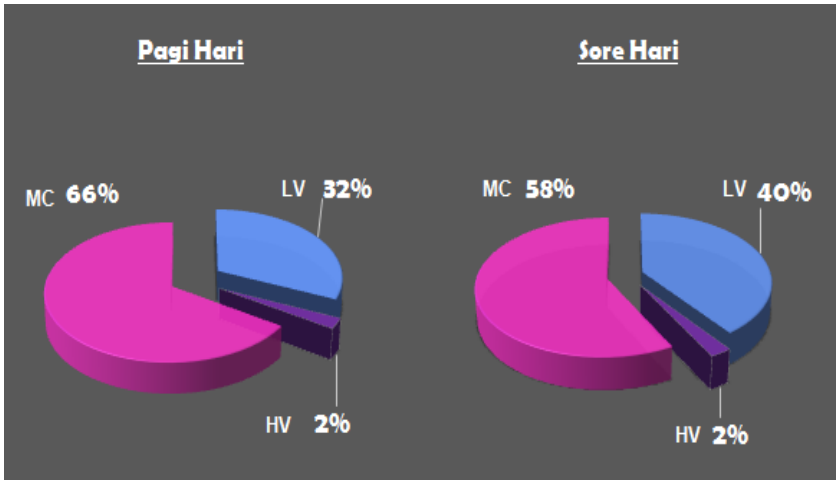

Fig. 4.1 Diagram of the composition of types of road vehicles Jatingaleh.
Resource: Analysis, 2014.

Table 4.1 Analysis of the causes of congestion in Semarang Jatingaleh.

No	Area Delay / Congestion	Factors Causing congestion
1.	Kesatrian intersection	The existence of a flow diversion towards Jl. Setia Budi-Jl.Teuku Umar to spin direction and also to enter the highway. not signalized Intersection between the main road of Jl. -Jl Teuku Umar. Setia Budi the driveway is Jl. Kesatrian There is a BRT bus stops located adjacent to the intersection
2.	PLN intersection	The presence of a meeting between the exit node B and Jl.Karangrejo toll section that caused traffic generation, the current make a right turn movement (against the current) or rotating. There intersection between vehicles who want to enter the expressway section C with the vehicle out of the way settlement (Jl. Jatingaleh II) Public transport stops for passengers ascending lower
3.	Jatingaleh Intersection	The existence of On Site Activity (Jatingaleh Market, stop in front of Jatingaleh markets, shops along the main road adjacent to the intersection) is potentially an increase in the amount of side friction, good car parking, play vehicles, pedestrians and pedestrian. on-street parking also occur along the front street markets and shops. There was traffic generation vehicle exit toll road section B and settlements (Jl. Jatingaleh I) which is often the turning direction at the intersection. The number of vehicles entering the toll to be piled in the front section C Jatingaleh market because the market lies adjacent to the entrance toll sections C and also close to the main road junction. Along the main road before the intersection Jatingaleh (from the direction of Jl. Setia Budi-Jl. Teuku Umar) many residential driveway that leads to the intersection of the bypass road median.

Resource: Analysis, 2014.

Table 4.2 Calculation of flow reduction on the Fly Over.

The movement of the Road from Jalan Setia Budi to Jalan Teuku Umar					
movement	periode	MC emp = 0.5	LV emp = 1.0	HV emp = 1.3	VJP (smp/jam)
Straight from the intersection 1 (Kesatrian)	morning	4270	2604	147	4930
	afternoon	4270	2604	147	4930
Straight from the intersection 2 (PLN)	morning	4623	1764	173	4300
	afternoon	2557	1911	152	3387
Straight from the intersection 3(Jatingaleh)	morning	4888	2249	113	4840
	afternoon	1999	1381	85	2491
average 1(morning)					4690
average 1(afternoon)					3603
The movement of the Road from Jalan Teuku Umar to Jalan Setia Budi					
movement	periode	MC emp = 0.5	LV emp = 1.0	HV emp = 1.3	VJP (smp/jam)
Straight from the intersection 1 (Kesatrian)	morning	2054	43	3	1074
	afternoon	2014	1767	80	2878
Straight from the intersection 2 (PLN)	morning	4365	1950	147	4324
	afternoon	4292	2339	106	4623
Straight from the intersection 3 (Jatingaleh)	morning	1310	675	147	1521
	afternoon	3440	1716	76	3535
average 2 (morning)					2306
average 2 (afternoon)					3679
average (morning)					3498
average (afternoon)					3641
Volume plan = 92.6 % * average (morning)					3239
Volume plan = 92.6 % * average (afternoon)					3371

Resource: Analysis, 2014.

Table 4.3 Comparison of traffic conditions after and before the Fly Over.

No	specifications	periode	before the Fly Over	after the Fly Over
1	Volume	morning	3498 (smp/jam)	3232 (smp/jam)
		afternoon	3641 (smp/jam)	3371 (smp/jam)
2	DS	morning	0,76	0,05
		afternoon	0,78	0,05

Resource: Analysis, 2014.

From the observations in the study area as shown in the table above, it can be hypothesized that the factors causing delays / congestion in the area Jatingaleh namely:

- On site activity along Jalan-Jalan Teuku Umar Setia Budi is quite dense and is located adjacent to the intersection, which is composed of the PLN office, Jatingaleh market, BRI office, tax office, as well as health centers and several restaurants along the main road opposite the market Jatingaleh;
- The existence of a plot intersection jointed and layout are not signalized intersections are adjacent to one another;
- Barriers side effect such as:

1. pedestrians

2. Public transport and other vehicles to stop. The occurrence of parking on the street for most of the main street corridor (Jl. Setia Budi-Jl. Teuku Umar)

3. Vehicles in and out of alleys along the main road.

4.2 Fly Over Effectiveness Analysis Fly Over

4.2.1. On the Fly Over Flow Reduction

After calculation of the reduction of the flow of vehicles across Jalan-Jalan Teuku Umar Setia Budi, routed through Fly Over. The calculation can be seen in table 4.2 below:

So plan the volume of vehicles that will pass through Fly Over as a result of the reduction of the flow beneath the vehicle (Jalan-Jalan Teuku Umar Setia Budi) of 3239 pcu / hour in the morning and 3371 pcu / hour in the afternoon.

4.2.2 Reduction of Total Flow After the existence of Fly Over

Movement patterns that occur in the area analyzed Jalan Semarang Jatingaleh of traffic conditions. Prior to the Fly Over most current vehicles occurred on Jalan Teuku Umar-Jalan Setia Budi and vice versa at peak hours because the road is a major road (main). For a comparison of the traffic condition, can be seen in Table 4.3 [19, 20].

5. Summary

5.1 Conclusions

From the analysis of research studies in the previous chapters can be concluded as follows:

1. Based on the identification of existing conditions, the factors that cause delays / congestion in the area Jatingaleh are:

- On site activity along Jalan Setia Budi-Jalan Teuku Umar were quite dense and is located adjacent to the intersection, which is composed of the PLN office, Jatingaleh market, BRI office, tax office, as well as the health center and several restaurants along the main road opposite the market Jatingaleh;
- The existence of a plot intersection jointed and layout are not signalized intersections are adjacent to one another;
- Barriers side effect such as:

Pedestrians

Public transport and other vehicles to stop. The occurrence of parking on the street for most of the corridor the main road (Jalan Setia Budi-Jalan Teuku Umar)

Vehicle in and out of alleys along the main road

The composition of the types of vehicles in the area of Semarang Jatingaleh, road users at peak hours is dominated by motor vehicle (MC) is 65.75% (morning) and 57.71% (afternoon) [21].

2. Performance of each of the forms Fly Over,

Underpass, and joint-Underpass Fly Over Fly Over is following the flow of traffic can be reduced by 93.42% (morning) and 93.59% (afternoon) while after the underpass is Underpass in the form Kesatrian and underpass in the area Jatingaleh only able to reduce 25.24% (morning) and 14.28% (afternoon). Of the two alternative models are clearly visible difference that the difference in terms of reducing the amount of current that is 68.18% this is due to the form of Fly Over is adding road capacity while the shape Interchange (underpass) just facilitate the flow and move the point of conflict. Where to condition the third model is the incorporation of forms Fly-Over Underpass bihannya Kele same as previously mentioned is able to increase the capacity as well as moving the point of intersection of the existing conflict. Besides, with the flow of traffic growth assumption of 2.92% per year of traffic flow prediction that is able to be served by any form of Fly Over> 20 years, the shape Interchange to 9 years and form merger Fly Over and Underpass > 20 years.

With the results of the calculations can be made a basic design Fly Over to increase the number of road capacity as follows:

5.2 Recommendations

Based on the analysis and review solutions congestion at intersections Jatingaleh edged in Semarang, it can be suggested the following matters:

- Completion and congestion control problem is something complex, meaning that the settlement should be done comprehensively, from start resetting traffic management to increase the capacity of the road to run and function optimally.
- Dilakukanya synergistic cooperation between the government of Semarang, related parties, as well as road users to order the use of roads, especially in the front area of the market in order to avoid point Jatingaleh delay / congestion.

Fig. 5.1 The basic design Jatingaleh Fly Over Semarang.

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