Traffic Management of Gunung Sari Intersection Base on Problem Solving Hierarchy

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Abstract. One of Gunung Sari traffic problem is its intersection. This intersection is a connection road from Mataram to North Lombok. The intersection is busy and will be busier for distributing many logistic dies to the last disaster, when many buildings was droken. In this research, it was found that the existing Degree of Saturated level is higher than the required level, do that is needed to do a management traffic design to solve the problem. The 1st alternatives for reducing the DS is using sign‘ don’t stop here’. Then, the second alternative is widely major road. The 3rd alternative is the combination of 1st alternative and the second one or sign for no stop area and widely the major road. All of the 3rd alternatives bring DS valeu more than the recomended that is 0.75. The 4th alternative is the combination of 3rd alternative and widely minor road. These alternative carries point 0.74, but due to the increasing number of vehicles, this alternative potential will be rejected in future. So, the last alternative is combining the 4th alternative and using traffic light. This alternative carries the level of DS between 35-72 on each side of Gunung Sari intersection.

Keywords: Density of Saturated, Intersection, performance

1. Introduction
One of the strongest aspects that can be city branding is image of the city. As known, image of the city built of path, edge, district nodes and landmarks. Every element has its own characters but they have to support each other’s to build up the same image. In many cases failure of city image is because of broken link or connection of each elements [1].
This research is developed from a believe that path is one of an important element that can be the representative image of the city. Path is built of road, pedestrian path, transit road, canal, railways and all of environment element that support transportation system [2]. In general, traffic problems of developing city, the number of vehicles and road performance is unequal, so it is potential to be traffic jam in future, parking (many developing cities have lack master plans; even some have no master plan. Because of that, many public facilities that needed parking area, such as markets, shops, schools, etc are built with uncontrolled), and unbalance of public transport demand and supply.
Gunung Sari intersection is one of the busy intersections in Gunung Sari, Lombok Barat regency. As a developing city, Gunung Sari also has the problem such as be mentioned above. On the preliminary research, it was found that the research location is an intersection road to go from Mataram, the capital city of West Nusa Tenggara to North Lombok regency, but the intersection is in West Lombok regency. So, the location of the intersection is in West Lombok, but it is the connection way from Mataram to North Lombok. It means the intersection will be busier of traffic in future [3].
The location and condition can be the strength of the research. In the other hands, that can be the weakness as well, due to the peak hours of the traffic that depends activities around. Because of that, it is needed many traffic surveyors for getting valid data.

![Figure 1. Gunung Sari Intersection](image)

The datas that be reached as geometric datas are showed on Table 1.

| Direction | wide | Approach | lane | Median |
|-----------|------|----------|------|--------|
| N         | 6.25 | 3.12     | 2    | -      |
| E         | 3.5  | 1.75     | 2    | -      |
| S         | 6.25 | 3.12     | 2    | -      |
| W         | 4    | 3.0      | 2    | -      |

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2. Method

On purposes of reach the scientific goal, this research was held on research methodology that guiding by 4 the steps. The method that be used on this research are surveys for collecting data and analyzing the data for reaching conclusion of existing condition and design recommendation for future. Research location was on Gunung Sari intersection and its influenced road network system. The surveys were done on 3 days when be representative of work days, weekend and holiday. The type of data is primary data and that are about: road and intersection geometric, traffic, intersection conflicts and side friction Research Instrument on this research was surveyors, tools and data analyzing. The factors that be analyzed to decide environment condition of the intersection

Type of environment
The intersection is around the area of: shops, administration service, school, mosque and resident, so due to MKJI 1997 on Sideman [4], the environment type is commercial land use, with a high traffic category.

**Side Friction**
The side friction is come from:

a) parking on street  
b) vehicles that entry or out of parking area  
c) Pedestrian  

Due to MKJI 1997 the type of side friction on the intersection area is **high side friction**

**City Size**
Population of West Lombok is 665.132, due to MKJI 1997 on Sideman [4], size of the city is intermediate city.

3. **Result and Discussion**
In this study, the primary data that be used for taking decisions are based on the traffic data of 3 chosen representative days. The 3 days are representative days of working day, weekend and holyday. Each day is the representatives’ days for a year.

The following tables are showing the traffic data.

**Table 2. Recapitulation of traffic volume every approach on work day**

| Times            | North | East | South | West |
|------------------|-------|------|-------|------|
| 08.00 AM-09.00 AM| 1619  | 974  | 470   | 1788 |
| 12.00 AM-01.00 PM| 2139  | 903  | 339   | 1530 |
| 06.00 PM-07.00PM | 1914  | 1067 | 472   | 1878 |

Table 2 shows that the highest number of vehicles come from north direction. If it is comparing to the road size on Table 2, north direction is one of the widest roads. So, it means north direction is one of the widest roads and it is the busiest traffic road.

On the other hand, east direction is the narrowest road (Table 2), but is not the lowest number of vehicles. It means this road has a problem of traffic.

The next point is about peak hours. Only north direction has peak hours on 12.00 AM – 01.00 PM, the others direction has on 06.00 PM- 07.00 PM. These dates will be analyzed as a part of performance. It is important to volume and capacities to get traffic delay on each road, as Fanera [5] wrote that road system performance is also estimate on delay that caused by intersection.

**Table 3. Recapitulation of traffic volume every approach on weekend**

| Time             | North | East | South | West |
|------------------|-------|------|-------|------|
| 08.00 AM-09.00 AM| 1406  | 925  | 389   | 1286 |
| 12.00 AM-01.00 PM| 1274  | 772  | 377   | 1228 |
| 06.00 PM-07.00PM | 1578  | 1133 | 476   | 2104 |

The tables 3 show that the peak hour of north direction for weekend is on 08.00-09.00 AM, and three others are on 06.00-07.00 PM. It means there is a different time of each peak hour just on north direction. It means it is needed to do the next analyzing on the holyday date that is shown on the bellowing table.

**Table 4. Recapitulation of traffic volume every approach on holydays**

| Time             | North | East | South | West |
|------------------|-------|------|-------|------|
| 08.00 AM-09.00 AM| 1388  | 11113| 650   | 1961 |
| 12.00 AM-01.00 PM| 1381  | 1010 | 321   | 1488 |
| 06.00 PM-07.00PM | 2003  | 1189 | 398   | 1714 |
Table 4 shows that on holyday, north direction and east direction have peak hours on 06.00-07.00 PM but south and west have on 08.00-09.00 AM. It proofs that on holyday; most of the vehicles are using the road for going to reach nature tourist part but on evening most of them go to business district center and housing areas.

Problem solving of the traffic will be started from the simplest one, respectively as following steps:

1. Using sign and mark, this alternative is the easiest alternative due to the cost and its following impact. Due to the differences size of each road, all the sign here will not design as traffic light.

2. Geometric, for example: widely road started from major road, because it will be easier due to side friction, namely houses and shops, then widely minor road, or secondary road. This alternative come from the believe that the degree of driver speed is also restricted of traffic volume [8].

3. Using traffic light, due to the maintenance and controlling that be needed, this alternative can be more difficult than the 2nd one, because it is needed to be evaluated regularly. It is caused of the traffic light cycle time is depend on existing condition and the design that will be reach on the planning year [7].

4. Changing pattern of vehicles moving, for example one direction for each road, it can be the next alternative due to its difficult following problem of destination route, based on the references that one-way direction system will bring an increasing saturation degree on the intersection [8].

5. Restriction of vehicles, this alternative can be the most difficult alternative due to the social problem that will be rise

In this research will be design 4 traffic engineering alternatives

1. design is to change the side friction by using sign don’t stop here
2. Second alternative is widely major road
3. Alternatives is the combination of 1st alternative and the second one or sign for no stop area and widely the road
4. combination of 3rd alternative and widely minor road

From the simulation of 1st alternative, it was reached that Saturated Density is 0,76. It will be decreased form the existing point that is 0.79, but it was not higher than the recommended point is 0,75. So this alternative is not recommended.

The result of 2nd alternative that is widely major road, was reached the saturated of Density is 0,77. It means this alternative brings a lower point but unfortunately is not better than the required even is higher than the 1st alternative.

The 3rd alternative is using sign of doesn’t stop here and widely major road. From this alternative, it was reached the point of Saturated Density is 0, 74. This point is higher than the required. The unique result is that the point of this alternative was the same with the first alternative; it means widely mayor road is not the guaranty for solving traffic proble of developing urban transportation. In many transportation cases these alternatives rise in the hope of solving problem. Due to the result this alternative is not recommended.

The last alternative is the combination all of the alternatives before and widely minor road. This alternative brought the point as much as 0,74. This point is lower than the required point, so this alternative is recommended, but then due to the possibility of increasing number of vehicles, it is recommended to find out an extra alternative that combine the 3rd alternative with using traffic light on the intersection. Due to the result it is needed a traffic engineering design on the intersection the Level of Service, as Ceunynck [9] wrote that the prime goal of setting traffic system is keeping safety transportation on intersection. Using traffic light brought this bellow point of Saturation Density for each

- North side  = 0,72
- West side   = 0, 35
- East Side   = 0,65
- South Side  = 0,7
4. Conclusion
From the existing road analysis, it was reached that the Saturated Density is about 0.79. This value is higher than that required by the Manual of Indonesian Road Capacity that is about by maximum 0.75. There are 3 alternative of problem solving for Gunung Sari intersection, namely: using sign of don’t stop here, widely mayor road, widely minor road, using traffic light and the combination of the alternatives, the best alternatives that be recommended is the combination of all of the items. The recommended alternative can reduce the degree of saturated until 0.35 on west direction road, which is lower than the required degree (0.75). It means by the recommended alternative the problem of Gunung Sari intersection will be solved.

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