A CRITICAL STUDY OF ROAD INTERSECTIONS IN THE SOUTH EAST PART OF SURAT CITY

Road intersection redesign study

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Abstract: South-East zone is the second most populous zone in Surat city with a population of 7.48 Lakh in the year 2017. The city with growing population faces high motorization rate that needs to be addressed. The rapid increase of motorization rates on the urban road mainly generates a lot of traffic problems like traffic delay, traffic accident, congestion, cost, environmental pollution and many more. An Intersection is a complex area which is designated for vehicles to change the direction to reach their desired location. And not only the vehicles but pedestrians also demand some space for crossing the road. This paper examined the traffic volume and signal phases characteristics at the selected intersection of South-East zone of the Surat city. In addition to this, the directional movement and conflict point analysis were also identified. For analyzing the problem of traffic congestion, classified volume counts, pedestrian counts were calculated for three days that are Saturday, Sunday and Monday. Data were collected through direct field survey and from the video of private shops on intersection characteristics, traffic volume, signal phase cycle. Furthermore, the un-authorized parking problems and inadequate traffic police were also found out at the selected intersection in the South-East zone of the Surat city. This paper found out the fact on the reduction of congestion through improving existing roadway conditions because the intersection is an integral part of the road section which can impart active involvement in reducing traffic delay problems. In this paper, the research findings were shown for the two selected intersection that is Model Town Intersection and Dindoli main intersection of the South East zone of the city.

Keywords – Road Intersection, South-East Zone, Surat, Traffic Congestion, Traffic Delay.

1. INTRODUCTION

Traffic congestion problems are the most pressing problems in many urban areas of Surat city. These problems are main bottlenecks in the free movement of the vehicles on the roads as well as the intersection. The traffic delay problems are mainly due to increase in population and, also due to unproductive use of road section. Road intersections are the major part of the road section which plays an important role in channelizing traffic movements. The various traffic congestion problems associated with the road networks are traffic delay, environmental problems, more cost due to more fuel consumption, traffic safety problems and many more. Thus, traffic congestion is the result of the gap between traffic supply and traffic demand. Urban road intersections are the major bottleneck and are the major strike of traffic delays. This is because at the road intersection vehicle approaches for different manoeuvring movements such as left turn, right turn, U-turn movements which seeks the same space at the same time by vehicles and the pedestrians. Thus, urban road intersections are the major critical points of safety capacity and delay and efficiency point of view.

Many researchers have performed similar studies related to traffic delay causes and characteristics at urban road intersection worldwide and are accounted in the literature. Geethu Lal, Divya L. examined traffic problems and various sustainable remedial measures such as intersection signalization, parking proper road markings and signs were suggested for intersection improvement (Geethu Lal 2016). Tolu Isaac Atomode had examined various traffic delay problems at a road intersection in Ilorin and suggested various traffic improving measures such as high occupancy public transportation system, off-street parking spaces, NO PARKING and NO WAITING signs at the intersection was suggested(Atomode 2013). T. U. Chowdhury, Shahriar Mohammad Raihan attempted to reduce the traffic congestion problems at Banani intersection of Dhaka city of Bangladesh. The solution provided was mainly increasing the road capacity and reducing traffic demand by changing intersection into one-way route thereby proposed Flyover Bridge and making U-turn at Banani intersection (T. U. Chowdhury 2016). Jacek Oskarbski, Lucyna Guminska had analysed signalized intersection in context of pedestrian traffic and suggested various measures such as reducing the number of green arrows which reduces the conflict points between vehicles and pedestrian, implementation of a fully-actuated traffic signal, correct sequence and phases of the signal(Jacek Oskarbski 2016).

Though some studies related to traffic problems such as environmental pollution, traffic delays and related issues at road intersection still demands consideration of various issues at local level. Moreover, idealized models to reduce traffic congestion at the urban road intersection still lack in the literature. So, in this paper, the traffic problems at urban road intersection Model Town Intersection where arterial road and the Sub-arterial road of South-East zone of Surat city crosses each other and Dindoli intersection where two sub-arterial roads meet were studied. Data were collected using field survey such as classified volume counts, pedestrian counts, directional movement, signal phase cycle and un-authorized parking was collected.

2. STUDY AREA

In Surat city, there are seven zones under Surat Municipal Corporation (SMC) among which South-East zone has 19.492 Km^2. area, the second highest population of 7,48,304 and highest decadal growth of 88.37% as compared to other zones of the city (Surat Municipal Corporation 2017). There is also a considerable slum population in the zone as well as small-scale industrial units that caters a lot of traffic on the roads. This causes chaotic traffic congestion on road networks as well as road intersections. For the study, two major critical intersections are taken that are Model Town Intersection and Dindoli intersection. At Model Town Intersection an Arterial road called Canal road of 60m and a Sub-arterial road called Dumbhal road of 36m crosses each other. Whereas at Dindoli intersection two Sub-arterial roads that are Godadara bridge road of 45m and Dindoli road of 36m having 2 lanes are crossing each other. At both intersections, a primary school and commercial complex are in proximity. Inadequate road width due to encroachment, illegal parking, inadequate road markings,

road signs and long queuing lines are identified within the area of study. To identify the problems due to the traffic issues and for the improvement in the Model Town Intersection and Dindoli intersection direct field survey was performed to collect the data. Classified volume counts, pedestrian counts, directional movement, signal phase cycle was carried out as direct field survey. Classified volume counts, pedestrian counts were calculated from the video of the private shops for Saturday, Sunday and Monday for 24 hours in all direction to get the traffic volume. The survey days were so chosen as one half working day (Saturday); one holiday (Sunday) and One full working day (Monday). Signal phase cycle was calculated using the stopwatchon the mobile phone. Conflict point analysis was also carried out for both the intersection. Peak hour volume count also worked out in all direction to identify the actual traffic volume. Traffic volume was converted into a standard unit called passenger car unit (PCU). Directional movements in 12 identified directions were also counted during the peak hours. Pedestrian volume and unauthorized parking volume were also calculated for 24 hours continuously for 3 days.

The survey location of Model Town Intersection and Dindolimain intersection is shown in figure 1 and 2. The map is generated using Q-GIS by geo-referencing the latitudes and longitudes of the intersection. The latitude and longitude of the Model Town Intersectionare 21.1889 and 72.8608 and for Dindoli intersection are 21.15428 and 72.86935. The existing design of Model Town Intersection and Dindoliintersection is shown in figure 3 and 4.

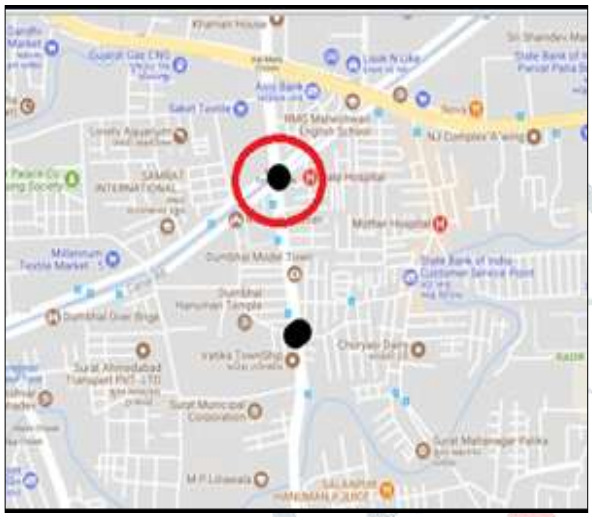

Figure 1 Location of Model Town Intersection

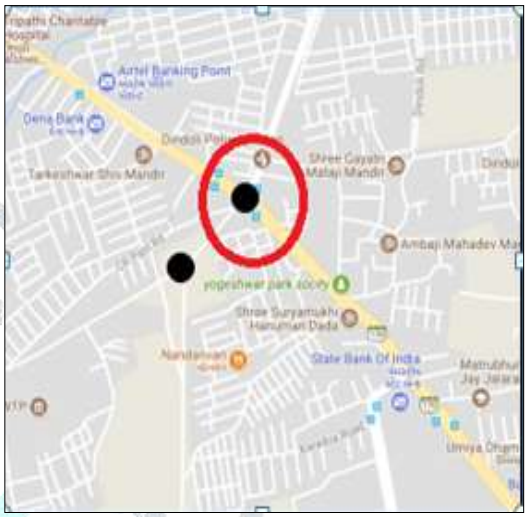

Figure 2 Location of Dindoli intersection

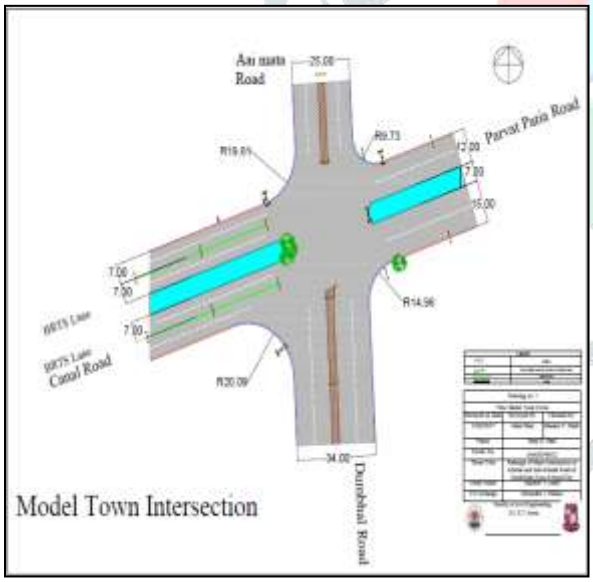

Figure 3 Existing situation of Model Town Intersection

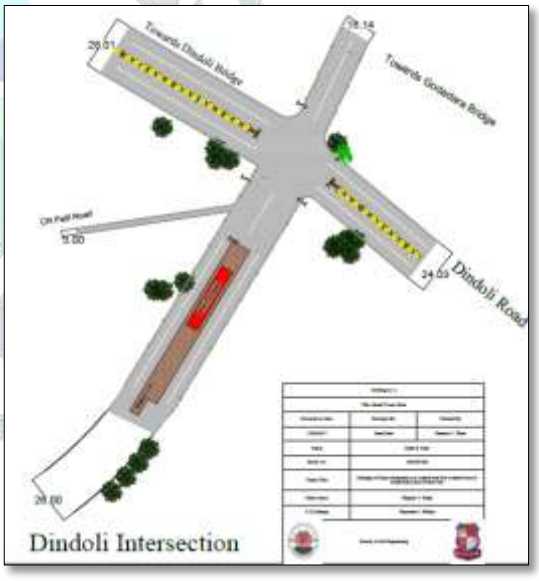

Figure 4 Existing situation of Dindoli intersection

3. DATA COLLECTION AND SYNTHESIS

In order to identify the critical issues emerging at both the intersection the collected field data were analyzed and are as shown in figure 5 and figure 6. The graph shows the PCU count, Pedestrian volume and Un-authorized parking during peak hours that is from 12:00-1:00 P.M. for Model Town Intersection and from 10:00-11:00 P.M. for Dindoli intersection.

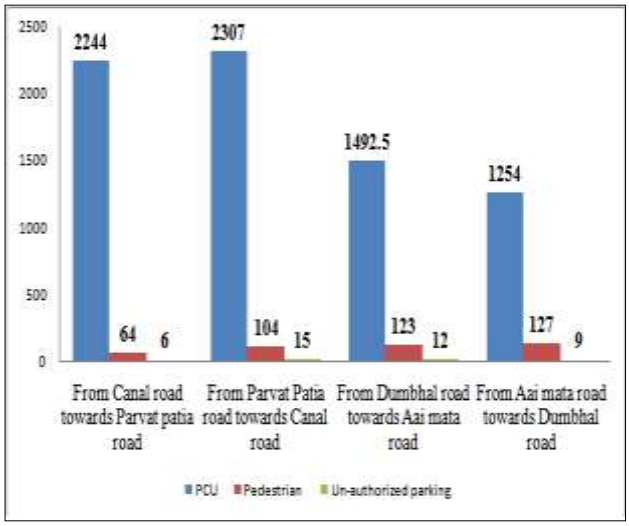

Figure 5 Traffic volume at Model Town Intersection

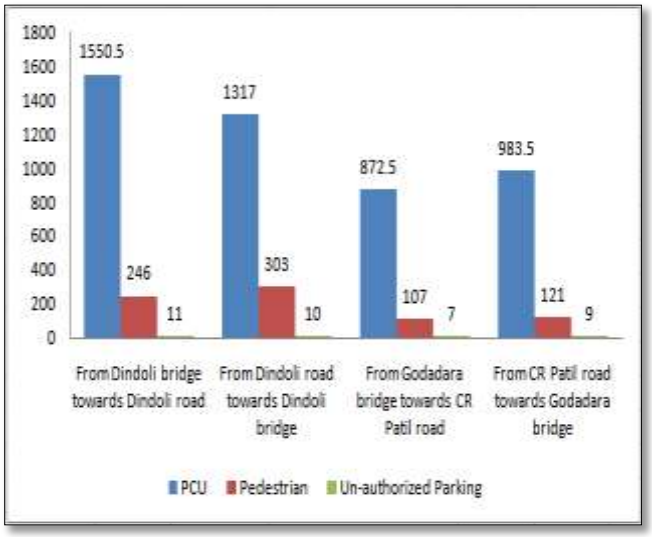

Figure 6 Traffic volume at Dindoli Intersection

3.1 DIRECTIONAL MOVEMENT

The directional movements consist of right turning movements, left turning movements and straightforward approach. The right turning movement at Model Town Intersection that is from Canal road towards Dumbhal road is 274.5 PCU. From Dumbhal road towards Parvat patia road is 247.5 PCU. While from Parvat patia road towards Aai Mata road is 265.5 PCU. And from Aai Mata road towards Canal road is 485 PCU. Now the left turning movement at Model Town Intersection that is from Canal road towards Aai Mata road is 1029 PCU. From Aai Mata road towards Parvat patia road is 261 PCU. From Parvat patia road towards Dumbhal road is 1008 PCU. From Dumbhal road towards Canal road is 236.5 PCU.

The right turning movement at Dindoli Intersection that is from CR Patil road towards Dindoli road is 273.1 PCU. From Dindoli road towards Godadara bridge is 1199 PCU. From Godadara bridge towards Dindoli Bridge is 1044.8 PCU. From Dindoli bridge towards CR Patil road is 485 PCU. The left Turning movement at Dindoli Intersection that is from Dindoli Bridge towards Godadara Bridge is 808.5 PCU. From Dindoli road towards CR Patil road is 565 PCU. From Godadara bridge towards Dindoli road is 923.5 PCU. And from CR Patil road towards Dindoli bridge is 575 PCU.

The figure 7 and 8 shows the total directional movement at both the intersection including left turn movement, right turn movement of all the 4 arms of the intersection.

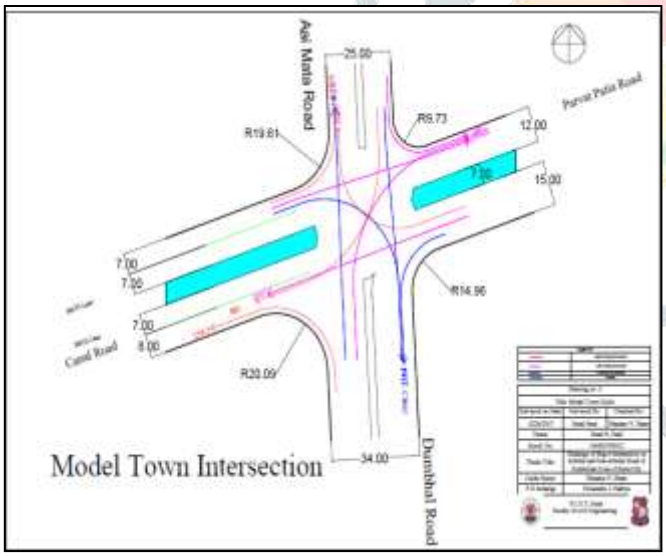

Figure 7 Directional movements at Model Town Intersection

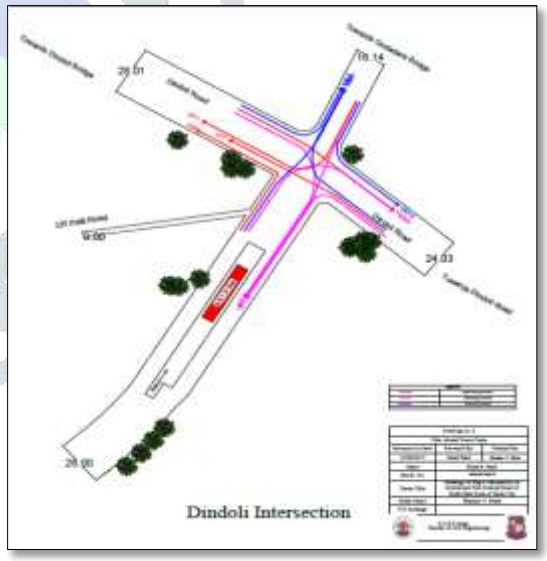

Figure 8 Directional movements at Dindoli Intersection

3.2 CONFLICT POINT ANALYSIS

The figure 9 and 10 shows the conflict point analysis at Model Town Intersection and Dindoli intersection.The conflict point analysis shows that at present there are 32 conflict points between vehicles from all direction for both the intersection. There is a lack of geometric and manual control of the intersection. The sole control through installed traffic signals is found to be inefficient. It results in possibilities for a higher degree of traffic conflict points at the intersection.

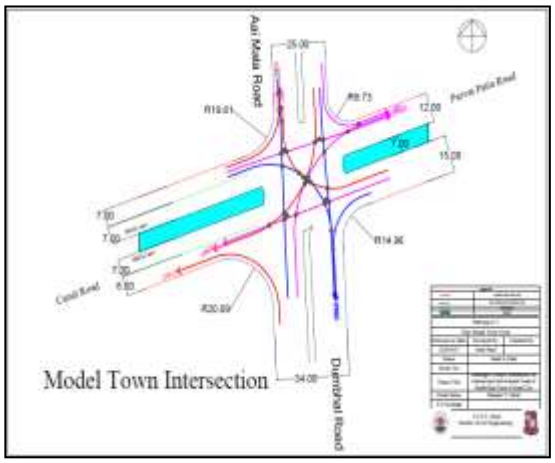

Figure 9 Conflict point of Model Town Intersection

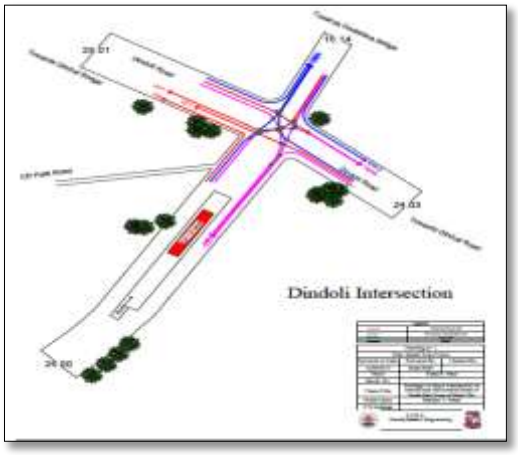

Figure 10 Conflict point of Dindoli Intersection

3.3 SIGNAL PHASE CYCLE

Model Town Intersection has four traffic merges where all the four merges are 2-lane one-way road type. For traffic control measure a pre-timed signal is there which contains four phases of traffic. But these signals are not followed by the traffic unless having traffic police to control the traffic. The optimum cycle length is 137.4 Sec which is quite significantin the context of IRC guidelines 67, 2012.The N-S phase and E-W phase concentrate to vehicle traffic with parallel pedestrian crosswalks. This causes conflicts between vehicular traffic and pedestrian traffic. Figure 12 shows signal phase cycle at Model Town Intersection. Below shown figure 11 and 12 are 'Not to Scale' and diagrammatic representation only for the signal phase cycle for intersection arms.

Figure 11 Signal phase cycle of Model Town Intersection

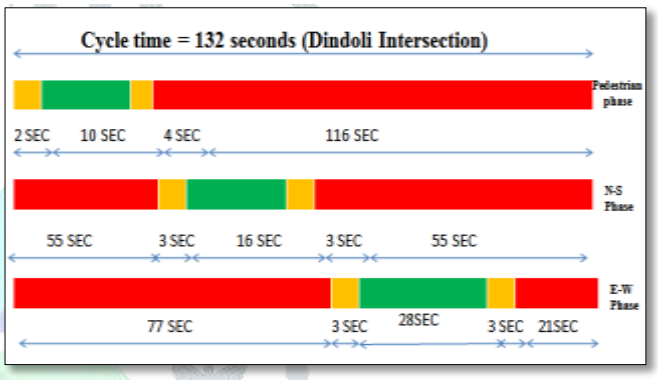

Figure 12 Signal phase cycle of Dindoli Intersection

Dindoli Intersection has four traffic merges. All these four-arms are 2-lane one-way type roads. These arms have 14 m right of way. For traffic control measure a pre-timed signal has installed that work in four phases. The optimum cycle length is 132 Sec which is quite significant in the context of IRC guidelines 67, 2012. Figure 13 shows the signal phase cycle of DindoliIntersection.

3.4 ROAD MARKINGS AND SIGNAGES

The road signs are there but are obstructed and are not clearly visible to the road users who create a lot of problem to the road users as shown in figure 14 and 15. The road markings at both the intersection are inadequate as the zebra crossing got lighten and are not visible to the road users as shown in figure 17,18,19,21and 22. The road user does not get adequate information about the road condition. This creates a lot of traffic congestion and the conflicts between pedestrian and the vehicular traffic.

4. CONCLUDING REMARKS

nThe study examined that due to rapid urbanization and increase in population the vehicular growth has increased tremendously which results in traffic congestion and various related problems. A case of primary urban intersections – Model Town Intersection and Dindoli intersection was taken as a study to identify the potential bottlenecks emerging due to traffic congestion and to solve the problems related to it. For the study, the direct field survey was carried out,and the data of traffic volume, direction movement, pedestrian volume, and signal phase cycle were collected. Analysis of the data revealed that poor road markings, improper planning, lack of road signs and irregular signal phase cycle generate and continue the problem of traffic congestion at both the urban road intersections. The various remedial measures suggested overcoming the traffic congestion problems are as follow:

- Improvement in the planning of existing design of intersection;
- Provision of parking space;
- Proper signalization with adequate traffic police;
- Adequate road markings and road signs should be provided to inform and guide the road users in advance;

Traffic control device such as traffic island should be provided to channelize the traffic movement and to reduce the conflicts.

Figure 13 Road sign at Model Town Intersection

Figure 14 Signal at Model Town Intersection

Figure 15 Un-authorized parking

Figure 16 Encroachment at Model Town Intersection

Figure 17 Road markings at Model Town Intersection

Figure 18 No zebra crossing at Model Town Intersection

Figure 19 Un-authorized parking

Figure 20 Improper Road markings at Dindoli intersection

Figure 21 Improper Road markings at Dindoli intersection

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6. REFERENCES

[1] Surat Municipal Corporation

[2] Atomode, T. I. (2013). Assessment of Traffic Delay Problems and Characteristics at Urban Road Intersections : A Case Study of

Ilorin , Nigeria ., *12*(4), 6–16.

[3] Chowdhury, T. U., Raihan, S. M., Fahim, A., & Bhuiyan, M. A. A. (2016). A Case Study on Reduction of Traffic Congestion of Dhaka City : Banani Intersection. *International Conference on Agricultural, Civil and Environmental Engineering (ACEE-16)*.

[4] Lal, G., Divya, L. G., Nithin, K. J., Mathew, S., & Kuriakose, B. (2016). Sustainable Traffic Improvement for Urban Road Intersections of Developing Countries: A Case Study of Ettumanoor, India. *Procedia Technology*, *25*(Rarest), 115–121. https://doi.org/10.1016/j.protcy.2016.08.088

[5] Onelcin, P., & Alver, Y. (2017). The crossing speed and safety margin of pedestrians at signalized intersections. *Transportation Research Procedia*, *22*(2016), 3–12. https://doi.org/10.1016/j.trpro.2017.03.002

[6] Oskarbski, J., Guminska, L., Miszewski, M., & Oskarbska, I. (2016). Analysis of Signalized Intersections in the Context of Pedestrian Traffic. *Transportation Research Procedia*, *14*, 2138–2147. https://doi.org/10.1016/j.trpro.2016.05.229

[7] Mohan Rao, A., & Ramachandra Rao, K. (2012). Measuring Urban Traffic Congestion – a Review.*International Journal for Traffic and Transport Engineering*, *2*(4), 286–305. https://doi.org/10.7708/ijtte.2012.2(4).01

[8] Mahajan, S. K., Umadekar, A., & Jethwa, K. (2013). New Concept of Traffic Rotary Design at Road Intersections. *Procedia - Social and Behavioral Sciences*, *96*(Cictp), 2791–2799. https://doi.org/10.1016/j.sbspro.2013.08.312

[9] Duan, M., Ya, H., Zhang, L., & Jia, H. (2013). Traffic Safety Analysis of Intersections between the Residential Entrance and Urban Road. *Procedia - Social and Behavioral Sciences*, *96*(Cictp), 1001–1007. https://doi.org/10.1016/j.sbspro.2013.08.114