STREAMLINING SAFE VEHICLE & PEDESTRIAN MOVEMENT THROUGH A TRAFFIC MANAGEMENT SCHEME

C. D. S. Maduwanthi, T. A. M. N. Gunarathna and K. S. Weerasekera*

Department of Civil Engineering, The Open University of Sri Lanka

INTRODUCTION

Kottawa town was selected for this study since it is considered as a town having severe traffic and pedestrian related problems. It was observed that many people, who enter the town, face problems daily such as drivers wasting time due to the traffic and pedestrians risk their safety. Kottawa causes severe traffic blocks since many motorists and pedestrians do not follow the prevalent rules and no proper traffic management scheme is operating currently. There are three junctions in the town. Colombo-Awissawella road (A4) and Athurugiriya road (B45) meet at the one junction which is a junction of three roads. Colombo-Awissawella road (A4), Horana road (B239) and one way road meet at the second junction and it is a junction of four roads. The third junction is also a four roads junction, old Kottawa road (B47), Athurugiriya road (B45) and one-way roads are meeting there (see Figures 1 and 2). Therefore considerable amount of vehicles are frequent within the three junctions in peak hour. Users of Southern expressway travel through Kottawa town since Makumbura interchange is situated next to Kottawa and all these motorists on A4 waste their time passing Kottawa. Stage one of Outer Circular Highway is now in operation and other two stages will be open sooner. Since it is also starting from Makumbura interchange and traffic will be increased at the town further. There are illegal constructions, and street vendors conducting their daily businesses on roadsides and it too is an obstruction. Hence these activities have reduced the capacity of the surrounding road network. Situation at Kottawa is further worsen due to roadside parking, large numbers of pedestrians crossing Colombo-Awissawella (A4) road and existence of two unplanned bus parking places at both side of the A4 road.

The aim of this study is to provide solutions to improve pedestrian movement, vehicle movement and vehicle parking facilities in the Kottawa town while improving overall safety. It is expected that through this study it will be possible to provide greater mobility, shorter travel times and easy accessibility with improved safety to all road users.

METHODOLOGY

Data collection and analysis

Data was collected through manual classified traffic counts and turning movement surveys. Turning movement surveys of vehicles at all three intersections at identified morning, day, and evening peak time periods were conducted. According to the collected turning movement data it was identified that 7:30 am – 8:30 am as the morning peak, 12:00 – 13:00 pm as day time peak, and 18:00 pm -19:00 pm as evening peak and by using this data road capacity analysis for each road was conducted.

Table 1. Summary of accident data for ten years (2003-2013)

Type of Accident	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Fatal	1	0	2	2	1	1	0	2	0	0	2	11
Grievous	7	1	5	4	3	3	5	7	2	5	7	49
Light	10	10	13	5	9	10	9	6	9	15	6	102

(Source: Police accident record books, Kottawa and Homagama police stations 2003-2013)

Corresponding author: Email - **kolitaw@gmail.com*

Accident data over the last ten years (2003 to 2013) at the study location were obtained from Homagama and Kottawa Police Stations. It was used to identify the locations where large number of accidents occurred and the type and nature of the accident were noted. Three types of accidents noted were; fatal, grievous, and light (i.e. property damage only) as shown in Figure 1. Traffic growth rates of different categories of vehicles in western province, both manual and automatic traffic count data around Kottawa town along the A4 road and recent survey drawings of study area were collected from Road Development Authority (RDA). With the opening of stage 2 and 3 of Outer Circular Highway (OCH) and Sothern Expressway extending beyond Matara, traffic in Kottawa town will be further increase.

Along all the road sections in the study area carriageway widths, number of existing lanes and walkway widths were measured in field. Peak hour flows in Makumbura interchange at year 2015 and daily traffic volume forecast of Sothern Expressway was obtained from final Design report of Southern Expressway in 2001, with kind permission from RDA which is much appreciated. Capacities of current road sections were calculated using manual traffic count data obtained during peak hours to check whether the road sections could handle the present flows. There will be an increase in the traffic flow due to vehicles leaving and entering the Southern Expressway and OCH at Makumbura interchange in future. Traffic growth due to above factors was used to analyse traffic flows in town area. According to the existing vehicle parking data, necessary arrangements were made to facilitate proper parking of vehicles. To provide safe and efficient movement to pedestrians, a questioner survey was conducted to obtain opinions based on three categories of pedestrians, drivers, and business community. Pedestrian counts of cross walks and side - walks carried out in the study area for year 2014. Then cross walks and side – walks analysis done for the forecasted counts in year 2034.

Capacity analysis and design

Capacity checks were carried out using the Highway Capacity Manual using turning movement data. Allowable flows were determined using observed data at a different Level of Services (LOS) for each lane and were compared with actual entry flows. If allowable flows are lower than the actual flow modifications were proposed to the road section layout and the suitability were checked. According to the study area there were three junctions and eight road-legs were to be observed. Road sections along the Colombo-Awissawella road were considered as multilane, undivided suburban road. All other road sections were taken as two-way, two-lane, rural roads. Different factors had to be taken to account in different conditions. Level of Service from B to E was used to check the capacity and shown in Table 2.RESULTS AND DISCUSSION

Following figure shows the locations where large number of accidents happened and the type of accident.

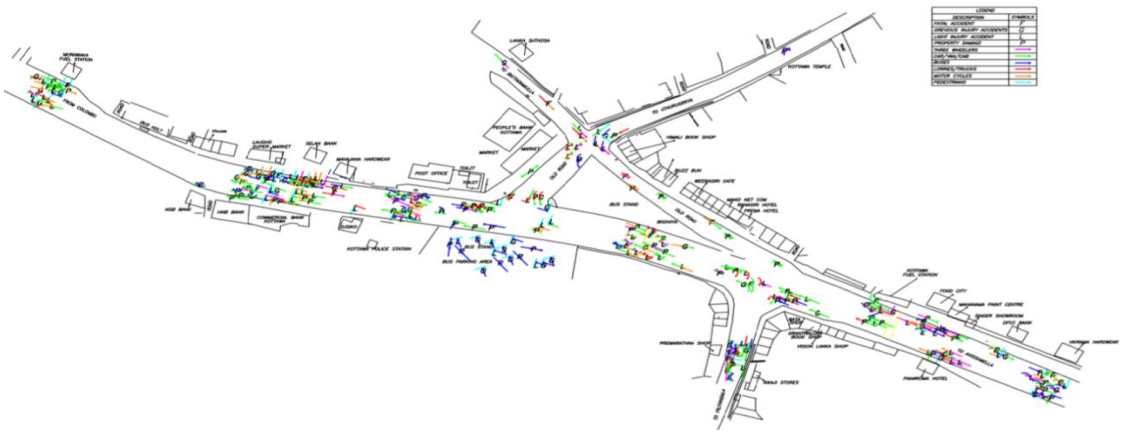

Figure 1. Collision diagram

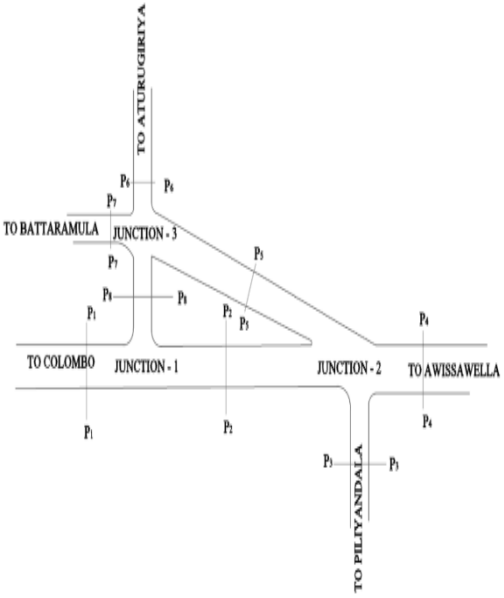

Figure 2. Road section locations

Table 2. Capacity analysis results

Road section	Road condition	LOS	Morning condition	Evening condition
P1-P1	Multilane undivided suburban	C	Satisfied	Satisfied
		D	Satisfied	Satisfied
P2-P2		C	Satisfied	Satisfied
		D	Satisfied	Satisfied
P4-P4		C	Satisfied	Satisfied
		D	Satisfied	Satisfied
P3-P3	Two-way Two-way two-lane, rural	C	Unsatisfied	Unsatisfied
		D	Unsatisfied	Satisfied
P5-P5		C	Satisfied	Satisfied
		D	Satisfied	Satisfied
P6-P6		C	Unsatisfied	Unsatisfied
		D	Satisfied	Satisfied
P7-P7		C	Satisfied	Satisfied
		D	Satisfied	Satisfied
P8-P8		C	Satisfied	Satisfied
		D	Satisfied	Satisfied

As per results it can be seen that capacity satisfied for Level of Service D in morning peak and evening peak for year 2014. But difference between the actual flow and allowable flow was insignificant. Hence actual flow will reach the allowable flow within few years. Year 2014 flows were projected to year 2034 and capacity analysis was conducted. Number of 3.7 m wide lanes required to satisfy the capacity are tabulated in Table 3.

Table 3. Number of lanes for year 2034

Location	LOS	No. - Per one direction
P1-P1	D	4
P2-P2	D	4
P3-P3	C	3
P4-P4	C	4

Location	LOS	No. - Per one direction
P5-P5	B	3
P6-P6	D	3
P7-P7	B	3
P8-P8	C	3

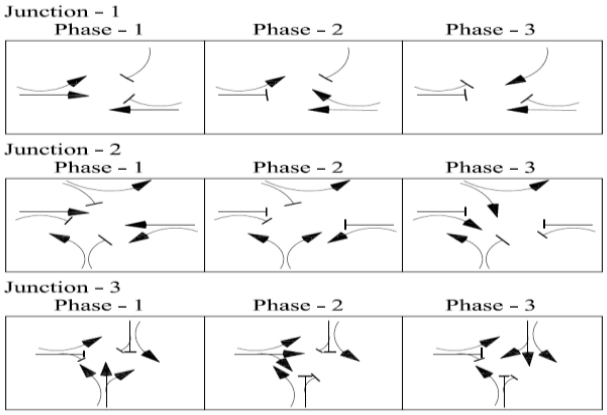

Figure 3. Phasing diagram

It was proposed to link traffic signals at three junctions with a roundabout at junction 3. From analysis a 7.75m radius roundabout was proposed at junction 3. Phasing diagram of signalized intersections shown in Figure 3. Final results of the traffic signal analysis are as follows.

Table 4. Traffic signal analysis results

	Morning Time	Evening Time
Cycle Time	120 secs	90 secs
Effective Green Time of Phase 1	33 secs	36 secs
Effective Green Time of Phase 2	20 secs	22 secs
Effective Green Time of Phase 3	55 secs	20 secs

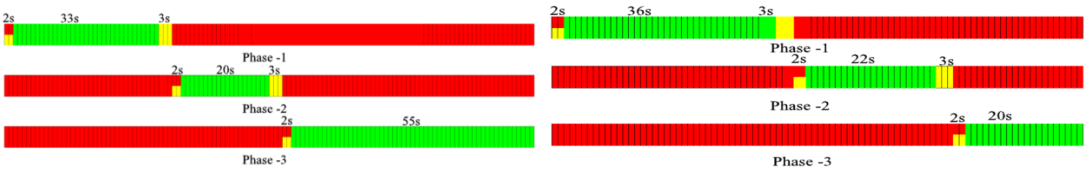

Figure 4. Signal timing diagram for morning and evening

12.00 noon was set as the signal settings changing time. At Kottawa town it was needed to provide suitable channelization to separate the opposing traffic with the traffic signal and roundabout. It is proposed to provide centre median to A4 road with semi-circular end shape. Length of the centre median was determined to suit site conditions, minimum width of centre median 1.2 m and radius of the semi-circular end as 0.6 m. Proposed centre median was indicated in final layout plan. In addition to channelization hand rail, turning regulations were too provided as suitable traffic management measures.

To facilitate a pedestrian level of service C (as per HCM2000), 2.0 m side walk width and 2.5m cross walk width were provided. As a solution for parking problems, most appropriate parking angle selected as the 90^0, level of service selected 1 for provide parking for future parking demand and Forty vehicles can parked in half story level and total 240 vehicles can be parked in multi-story car parking arrangement proposed and it is indicated in final layout.

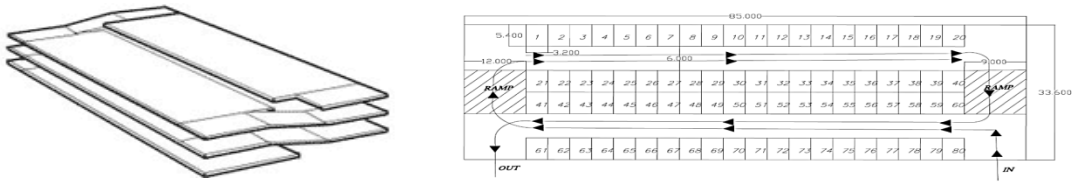

Figure 5. Split level car park arrangement and vehicle circulation pattern

Proposed final bus bay design and bus parking arrangement is given in the final layout according the AUSTROADS requirements.

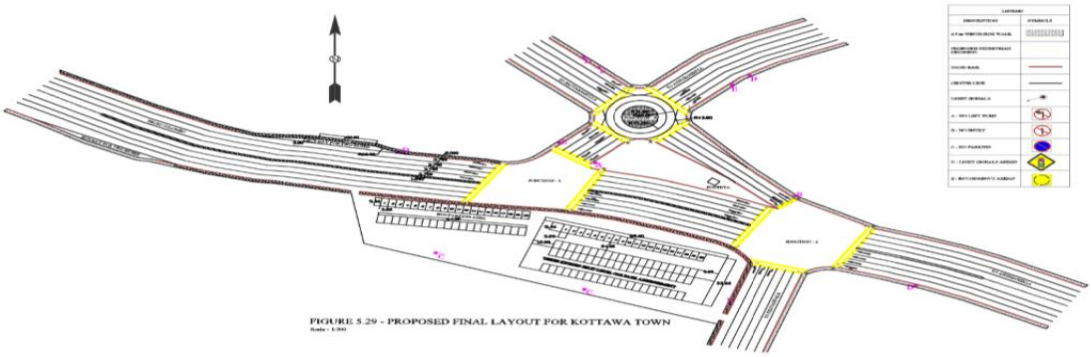

Figure 6. Proposed final layout

REFERENCES

Highway Capacity Manual (HCM2000), Transportation Research Board, National Research Council, Washington DC, USA.