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IMPROVEMENT OF TRAFFIC FLOW AT KANDY RAILWAY JUNCTION

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INTRODUCTION

The junction near the Kandy railway station is one of the busiest in Kandy town. There is a heavy vehicular traffic movement in and out of this junction, as two major roads meet here. The railway track which is proceeding towards *Matale*, crossing *S. W. R. D. Bandaranayake Mawatha*, causes traffic obstruction at the site due to closure of railway gate intermittently (Figure 1). Several main government institutions such as, railway, telecom, postal, education, main bus-stand, and *Bogambara* stadium are located around the railway junction. Past accident records collected from Kandy traffic police indicate that some fatal and serious nature accidents have taken place around the area due to heavy pedestrian activity. The problem of traffic congestion is aggravated on one hand by inadequate road widths, narrow unguarded foot walks, undisciplined behaviour of pedestrians and drivers, improperly located bus stands and pedestrian crossings etc., and on the other hand by hawkers occupying foot walks and shops encroaching on to the foot walks leading to a reduction in walking space for pedestrians.

It is expected to study the existing situation and propose a road improvement to allow the traffic to flow smoothly. The objective of this study is to increase the number of lanes and carriageway widths, after studying the current traffic and pedestrian flows, and design for a period of twenty years.

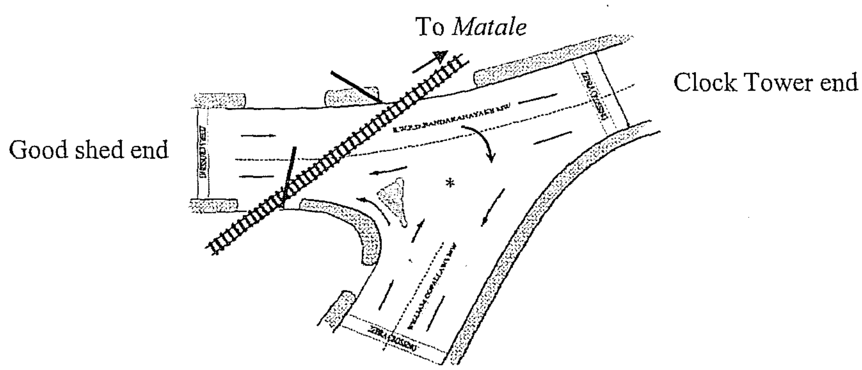

Figure 1 - Layout Plan

METHODOLOGY

- Conduct relevant traffic surveys to identify peak hour traffic flows, and turning movements by different vehicle categories at railway junction.
- Analyse traffic survey data, and carryout road capacity computations.

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- Evaluate the Levels of Service (LOS) of roads with present traffic flows and the LOS of the designed roads for projected traffic after twenty years.

TRAFFIC SURVEYS

Identification of Peak Hours

The traffic flow of a road does not remain constant throughout the day or week, but varies both in space and time. The *peak hour* represents the most critical period for operations and has the highest capacity requirements for a given location. Therefore, capacity and other traffic analysis has to focus on the *peak hour flows*. Kandy has a 5% annual traffic growth rate. A major base road (*William Gopallawa Mawatha)* was selected to carryout the traffic survey on a weekday from 6.30am to 9.30am, 12.00noon to 2.00pm, and 4.30pm to 6.30pm, and on weekend from 7.30am to10.30am, 12.00noon to 2.00pm, and 4.00pm to 6.00pm, when the traffic is at its heaviest, in order to identify the three peak hours of the day during morning, mid-day, and evening respectively. Counts were recorded at 15min intervals.

	Peak Hours for week days	No. of vehicles	Peak Hours for weekend	No. of vehicles
Morning Peak	7.00am-8.00am	1821	9.30am-10.30am	1947
Mid-day Peak	12.30pm-1.30pm	1746	12.30pm-1.30pm	1869
Evening Peak	5.00pm-6.00pm	1621	4.15pm-5.15pm	1624

Table 1- Identified Peak Hours *(William Gopallawa Mawatha)*

Classification of vehicles

The vehicles observed during the peak hours of weekday and weekend in each of the three roads, were categorized in to ten separate groups. Passenger Car Unit (*PCU*) is used for expressing various types of vehicles having different characteristics by a common equivalent unit. One passenger car is considered as the standard unit, and motorcycle causes less inconvenience to other traffic in the stream than a car and hence, it is considered equivalent to half a passenger car unit. A bus causes greater inconvenience to the other traffic. It is estimated that a single bus causes inconvenience equivalent to three passenger car units. Different vehicles having different dimensional and operational characteristics are also represented by *PCU.* It may also be considered as a measure of the relative space requirement of a vehicle class compared to that of a passenger car under specified set of roadway, traffic and other conditions. Vehicles in different terrains have different passenger car unit values. *PCU* factors for vehicles in flat terrain were considered due to the nature of the site.

Turning movement survey

Turning movement survey was carried out during the weekday and weekend, for the stated ten vehicle categories during the identified peak hours, to study the traffic turning movements at the railway junction. This junction is a channelized intersection. All the roads have two lanes in each direction and it has a mixed flow pattern consisting of crossing, diverging and merging movements. Diverging and merging from left side, do not cause much problem but, crossing, and diverging to and merging from right cause conflicts and difficulties to traffic moving on straight path. The volume of vehicles making each turning movement is not constant during all three peak hours. It changes from one period to another and also within the *peak hour*. At present, traffic at the intersection is controlled by a policeman to minimise congestion during peak hours.

CAPACITY ANALYSIS AND DESIGN OF ROADS

From the data collected from the traffic surveys, existing actual flow rates and the Levels of Service (LOS) during the peak hours were calculated. Then the road was improved to cater to the traffic volumes after 20 years.

Basic Definitions and General equations for designing *(According to the Highway Capacity Manual 1985)*

Peak Hour Factor (PHF)

The maximum hourly volume of the day divided by the rate of flow during period peak 15-minute within the *Peak Hour* is a measure of traffic demand fluctuation within the *Peak Hour*.

Peak Hour Factor *(PHF)* = Hourly volume / Peak rate of flow (within the hour)

$$PHF = V / (4 \times V_{15})$$

Service Flow (SF)

The actual rate of flow for the peak 15minute period expanded to an hourly volume and expressed as vehicles per hour or vehicles per hour per lane.

$$SF = V / PHF$$

Multilane highways

Capacity analysis and design was carried out for each of *William Gopallawa Mawatha* and to the two ends of the *S.W.R.D.Bandaranayake Mawatha.* Basic relationships for multilane highways *(According to the Highway Capacity Manual, Transportation Research Board 1985)*

$$SF_i = c_j \times (v/c)_i \times N \times f_w \times f_{HV} \times f_E \times f_p$$

$$f_{HV} = 1/ [\, 1 + P_T (E_T - 1) + P_B (E_B - 1)\,]$$

Where,

SF_i = service flow rate; the maximum flow rate that can be accommodated by the multilane highway segment under study, in one direction, under prevailing roadway and traffic conditions, while meeting the performance criteria of LOS *i*, in vph.

c_j = capacity per lane for a multilane highway with design speed *j*

N = number of lanes in one direction

$(v/c)_j$ = maximum volume-to-capacity ratio while maintaining the performance characteristics of LOS *j*

f_w = adjustment factor for lane width and/or lateral clearance restrictions

f_{HV} = adjustment factor for the presence of heavy vehicles in the traffic stream

f_E = adjustment factor for the development environment and type of multilane highway

f_p = adjustment factor for driver population

E_T, E_B = passenger car equivalents for trucks and buses respectively

P_T, P_B = proportion of trucks and buses respectively in the traffic stream

RESULTS AND DISCUSSION

Table 2 indicates the summary of the present and future situations.

Location	Before Design	After Design
William Gopallawa Mawatha	Level terrain Lane width 3.25 m No shoulder 4-Lane, two way road Obstruct on one side of roadway Actual flow 1075 vph LOS = C, & $(v/c)_i = 0.51$	Level terrain; lane width 3.66 m & shoulder width 1.83 m 6-Lane(3- lanes each direction), two way road Obstruct on one side of roadway Predicted flow rate 2856 vph LOS = C, & $(v/c)_i = 0.75$
S.W.R.D.Bandaranayake Mawatha- Clock Tower End	Level terrain Lane width 3.05 m No shoulder 4-Lane, two way road Obstruct on both sides of roadway Actual flow 1145vph LOS = C, & $(v/c)_i = 0.5$	Level terrain; lane width 3.66 m & shoulder width 1.83 m 6-Lane(3- lanes each direction), two way road Obstruct on one side of roadway Predicted flow rate 3037 vph LOS = C, & $(v/c)_i = 0.75$
S.W.R.D.Bandaranayake Mawatha- Good Shed End	Level terrain Lane width 3.35 m No shoulder 4-Lane, two way road Obstruct on both sides of roadway Actual flow 800 vph LOS = B, & $(v/c)_i = 0.34$	Level terrain; lane width 3.66 m & shoulder width 1.83 m 6-Lane (3- lanes each direction), two way road Obstruct on one side of roadway Predicted flow rate 2124 vph LOS = B, $(v/c)_i = 0.5$

Table 2 - Results of existing and design roads

CONCLUSION

According to the above study, it is seen that the present capacity of the intersection is not adequate, and improvement is needed to overcome the existing traffic congestion at the studied intersection. With suggested improvements initially the LOS of all three roads will improve, but in 20 years time it will reach the present levels of services in all roads. Hence a new design was conducted to accommodate forecasted traffic flows for a design period of twenty years.

REFERENCES

"Highway Capacity Manual" (1985), Special Report, Transportation Research Board, National Research Council, Washington, D.C.