# The Effect of Roadside Elements on Drivers' Speed Selection and Lateral Position on Road

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***Abstract*- Highway related crashes are considered as one of most concerned types of problems in the modern world. Run-Off-Road (ROR) crashes could be identified as the most critical among highway related crashes. Previous research studies on Traffic Engineering has found that the road side elements will have a positive influence toward ROR crashes. Hence, the study explores the relationship of roadside elements with drivers' speed selection and lateral position. In this research study, the effect of road side vegetation and utility poles on drivers' speed selection and lateral positioning was evaluated. A straight roadway section and horizontal curve roadway section with varying road side vegetation were selected to get the required data for the study. Fifty vehicle were observed at each location to get the speeds and lateral positions. Collected data was analyzed using Multiple Regression Analysis technique to generate models to find drivers' speed selection and lateral positioning of vehicle on road. Study found that in lightly vegetated roadways, subjects drove speedier and drove much near the edge of the road. At the point when the scene changes into more vegetated, subjects drove much slower and drove near to the center of the road. The models demonstrate that the impact of road side vegetation way much higher in curved roads areas than straight segments. Therefore, it is recommended to post a speed limit sign and proper monitoring system at each critical curved roadway section in the country.***

***Keywords: Lateral Position of Vehicles, Vehicle Speed Selection, Multiple Regression Analysis***

## I. INTRODUCTION

According to the World Health Organization (WHO), over 1.2 million people lost their lives each year in motor vehicle crashes and disabled millions of people annually around the world [1]. In the year 2013, 1.25 million deaths occur due to road traffic crashes and similar number get injured in 2014 [1]. Fatalities occurred in Sri Lankan road system has recorded over 2,700 in year 2015 which was an increase of more than 300 from 2014 [2]. The statistics further showed that 7.5 people died each day in 2015 which an increment from 6.6 in 2014. Single-vehicle crashes were considered to be the most critical with nearly 60 percent of all road crashes. In year 2014, traffic crash fatalities statistics implied that the maximum number of fatalities were due to crashes involving motorcycles (1,035 deaths) followed by three-wheelers (363 deaths), lorries (338 deaths), and private buses (220 deaths) [2].

The single-vehicle ROR crashes usually involved with roadside objects. Based on crash data in the United States (US), single-vehicle collisions with trees account for nearly 25% of all fixed object crash each year, resulting in deaths of approximately 3,000 people and making up approximately 48% of fixed-object fatalities [4]. Statistic reports in year 2005 showed that ROR crashes resulted in 31% of fatal crashes, but were only 16% of all crashes [4]. It implied that the severity levels were much higher for these when comparing to other types of crashes. When considering road traffic statistic data in Sri Lanka during 2002, out of 2,308 fatal crashes, 1,150 (58%) were single-vehicle crashes [5]. In the same year, about 64% ROR crashes were reported out of 18,950 single vehicle crashes [5].

Roadside elements could be identified as a major factor which affect drivers' speed selection and lateral position on the road. Roadside vegetation, utility poles, traffic poles, guard rails, crash cushions, breakaway posts, roadside embankments, and sign posts are some examples for roadside elements. Roadside vegetation may play a critical role to choose the speed and lateral position of vehicle in road way sections. Roadside vegetation plays a critical role on mitigating negative impacts to the human and environment. Providing shade, leading to lower pavement temperatures and decreased emissions are some of the positives [6]. Also, it provides positive psychological implications, such as reduced stress, alleviated depression, and expedited recovery from injuries. Even though roadside vegetation provides such psychological and environmental benefits, they pose a potential risk to drivers when placed within proximity to the traveled way [6]. When there is an open landscape without trees at the roadway, people drive faster, away from the road center [7]. With the increasing of the street trees, the risk of injury and fatal crashes increases as it causes more ROR crashes [7].

The injuries and fatalities due to single vehicle-collision are a significant component of road crashes in Sri Lanka. Hence, considering the effect of the roadside elements when designing the roadways helps to eliminate this thread and it will create efficient travel and transportation system in the country. The objective of the study was to evaluate the drivers' speed selection and lateral position from the presence of roadside elements within proximity to the traveled way.

## II. LITERATURE REVIEW

Roadside elements pose a potential tread to the drivers while they drive on roadway. Various research studies have been conducted to identify the effect of the roadside elements on highway crashes. To study the effect on the driver speed selection process, Fitzpatrick conducted a static evaluation on both real and virtual roads containing four combinations of clear zone size and roadside vegetation density [6]. With the increment in width of the clear zone, the speed limits of the vehicles increased gradually. Also, when the vegetation density increased for a large clear zone, drivers placed their vehicles further away from the shoulder of the roadway.

The effect of the roadside, geometric, and traffic control device variables on drivers' behavior in suburban arterials were discovered by Kay-Fitzpatricks [8]. When speed limit was not considered, lane width was the only significant variable for straight sections. For curve sections, the impact of median presence became significant together with roadside development. Horizontal curve radius or degree of curvature was a key variable for explaining the variation of speed on a curve. Motorist's perception and visual character of landscape elements in the non-paved portion of the roadway section were used to achieve a relationship [9]. The study found that the proper implementation of the design of theses roadside elements will enhance both safety and cost effectiveness.

Speed could be identified as a critical factor when considering the mobility and the safety across the surface transportation network [10]. Based on the collected data from the driving simulator and the real world, it was found that the drivers were underestimating the travel speeds in both environments. A consistency in the trends associated with both the speeds selected and perceived could be seen in varying land-use and speed limit [11]. Computer simulation models were developed representing some real-world roadway sections with varying roadside environment. The results suggested that white pavement treatment produced more moderate speeds and larger speed change, a desirable traffic calming effect. The road edges and medians had an effect on drivers' speed selection and lateral movement. The relationship of the effect of road-shoulders and presence of roadside trees with the drivers' behavior was observed by Abele and Møller [12]. A real world and driving simulator experiment on varying those parameters was conducted to achieve the results. The results showed that the road-shoulders did not have an influence on reducing the speed of the drivers but it made drivers to position their vehicle close to the edge of the road.

## III. Methodology

In this study, the lateral position and speed of vehicles in different vegetation densities were observed. The observations were carried out in two phases. In the first phase, straight roadway sections were observed and in the second phase horizontal curve roadway sections were observed.

### A. *Study Area*

A straight section at the Densil Kobbekaduwa Mawatha, Battharamulla was selected for the study. Densil Kobbekaduwa Mawatha is a main access road to the Parliament of Sri Lanka and some other key Authorities. The road is consisting of two lanes on both direction and a lane width is approximately four meters. This roadway has a three-meter width pedestrian walking path. Three sections were selected with light, medium and heavy vegetation density to get the required data.

As the horizontal curve roadway, Arangala-Kottawa road was selected. The road was classified as a B class road with a lane width of approximately 5.8m. The roadway consist two lanes for both direction and there is a 1m space for pedestrians to travel from the shoulder marking line. Three roadway sections with a horizontal curve with approximately same radius of curvature were selected. These three sections were consist of light, medium, and heavy roadside vegetation.

### B. *Identifying Critical Parameters*

Parameters affecting drivers' speed and lateral positioning of the vehicles on the road were chosen based on literature review and interviewing licensed-drivers who use this roadway. The chosen variables were: lane width, presence of vehicles following you, presence of guard, rails/barriers, pedestrian activity, posted speed limit, weather, known presence of police enforcement, internal distractors, shoulder width/type, time of day, density of roadside vegetation, presence of oncoming vehicles, presence of passengers, and proximity of roadside objects. A survey was conducted to filter the most critical factors which may create an impact towards the drivers' speed selection and lateral positioning on the road. Fifty licensed drivers were participated in the online survey to rank the above-mentioned factors according to their perspectives. Eight variables were selected for further investigation and tabulated in Table 1 and described in following sub-sections.

TA BLE 1. Summary of Variables

| Variable | Notati on | Definition |
|---|---|---|
| Proximity to roadside objects | RO | Numeric variable, measured in meters. |
| Vehicle condition | VC | Nominal Variable (0= "New", 1= "Medium"', 2= "Old") |
| Gender of the driver | GD | Nominal Variable (1= "Male", 2= "Female") |
| Age of the driver | AD | Nominal Variable (0= "18-25", 1= "26-35", 2= "36-50", 3= "50<") |
| Passengers on board | PO | Numeric variable, measured in numbers |
| Number of pedestrians | NP | Numeric variable, measured in numbers |
| Width of pedestrian walkway | WW | Numeric variable, measured in meters |
| Lane width | LW | Numeric variable, measured in meters |
| Vegetation Density | VD | Nominal Variable (0= "Light", 1= "Medium", 2= "Heavy") |
| Vehicle Speed | VS | Numeric variable, measured in Kilometers per hour |
| Lateral position of the vehicle | LP | Numeric variable, measured in meters |

*1) Proximity of roadside objects:* The distance between roadside elements to the edge line of the pavement shoulder could be a varying factor in roads. If the distance is marginal, it would create doubt on drivers' mind on how to drive safe on the road.

*2) Vehicle condition:* Vehicle condition defined as new, old, or in-between. Condition of the vehicle can be determined using the registration number of vehicle as in Sri Lanka, the registration numbers are issued in sequence order. Vehicles registered after year 2013, received three-letters following dash and four-numbers and the rest had two-letters or two-numbers following dash and four-numbers. The vehicles with two letters in the first part were registered between 2000 and 2013 and considered as medium-aged and the vehicles with two numbers were considered as old vehicles. Vehicles with three letters in the first part considered as new vehicles.

*3) Gender of the driver:* Driving pattern of a male driver compared to a female driver may slightly different. Men and women show less difference in causing single-vehicle crashes, but women show a higher tendency to be at-fault in multi-vehicle crashes [13].

*4) Age of the driver:* Considering age, drivers were categorized in to three different groups: young, middle aged, and old. Age of the driver was identified with visual observation while s/he was driving.

*5) Passengers on board:* When considering the safety of the passengers on board, drivers might be more selective on their speed and position on the road.

*6) Number of pedestrians*: It is a responsibility of a driver to ensure the safety of the pedestrian. If there are more pedestrian traveling on the sidewalks drivers will gradually speed down the vehicle.

*7) Width of pedestrian walking path:* If the pedestrian sidewalk lane width is marginal, it would create a doubt on drivers' mind on choosing an appropriate speed on the road.

*8) Lane width:* if there is a marginal lane width, drivers' will not have enough space to control the vehicle on the road. Therefore, they tend to show down the vehicle when there is marginal lane width.

### *C. Static Evaluation*

Each selected location, about 50 random drivers were observed and collected the information on all the variables listed in Table 1 together with their speeds, lateral positioning. The speed of the vehicle was detected using a radar gun. A video camera was set up at each location to measure the lateral position of the vehicle on the road. Lateral position of the vehicle was measured by analyzing the video tapes recorded at each location. Vehicle registration number of each vehicle was observed to determine the condition of the vehicle. The width of the lane and the pedestrian side walk were measured using a measuring tape. The gender of the driver, approximate age of the driver, and the passengers on board were also observed.

Since, the locations were identified in same roadway, the effect of lane width and pedestrian walking path, design speed were not the variables. The data were collected during same time at the same day. Therefore, the traffic flow can be assumed as same in each and every location. Random passenger cars were observed and the required data were recorded while there was a medium traffic flow. The impact of the traffic control devices, intersections and other infrastructure facilities towards the selected three location were equal. Quantitative data were collected on condition of the vehicle, gender, approximate age of the driver, vegetation density, and vehicle condition. Speed of the vehicle, passengers on board, number of pedestrians in the walkway, and lateral position were quantitative data.

### *D. Data analysis*

Multiple Regression Analysis was used for this study. Multiple regression is an extension of the simple linear regression [14]. It is used to predict the value of the dependent variable based on the value of two or more independent variables. All the variables which were defined in Table 1 were inputted to SPSS software to develop the models for speed and lateral position of the vehicle on the road. The SPSS regression analysis output results provide a comprehensive overview of the model created.

#### *1) Straight Road way section*

*Correlation coefficients*: When selecting independent variables, it is important to select only the variables which do not have any correlation effect on other independent variables. Therefore, the correlation matrix was developed and noted the highly-correlated variables. As shown in Table 2, walkway width and the vegetation density had high correlation coefficient (0.75) with *p-value* less than 0.05 and therefore those were the highly-correlated variables. When developing the model, included only one variable out of two that helped to get the better fit model. Also, walkway width and proximity to roadside objects were correlated variables. All other correlation coefficients were less than 0.15 and therefore, none of them were correlated variables.

TABLE 2- Correlation Coefficient Metrix

| Variable | GD | AD | VC | PO | NP | RO | WW | VD |
|---|---|---|---|---|---|---|---|---|
| **GD** | | 0.003 | 0.610 | 0.003 | 0.000 | 0.007 | 0.008 | 0.004 |
| **AD** | 0.003 | | 0.005 | 0.188 | 0.001 | 0.106 | 0.074 | 0.021 |
| **VC** | 0.610 | 0.005 | | 0.024 | 0.000 | 0.020 | 0.026 | 0.041 |
| **PO** | 0.003 | 0.188 | 0.024 | | 0.001 | 0.005 | 0.047 | 0.137 |
| **NP** | 0.000 | 0.001 | 0.000 | 0.001 | | 0.102 | 0.142 | 0.091 |
| **RO** | 0.007 | 0.103 | 0.020 | 0.005 | 0.102 | | 0.600 | 0.113 |
| **WW** | 0.008 | 0.074 | 0.026 | 0.047 | 0.142 | 0.600 | | 0.750 |
| **VD** | 0.004 | 0.021 | 0.041 | 0.137 | 0.091 | 0.113 | 0.750 | |

*Model fit statistics:* The '*R-Square*' value provides a statistical measure of how close the data are to the fitted regression line. Having a low *R-squared* value suggests that the data set is deviated from the regression line. The '*F-value'* gives the ratio of mean square of regression to mean square of residual. When considering 95% of confident level the *'F-value'* fits to the estimated curve.

#### *2) Curve Roadway section*

Correlation coefficient: The correlation matrix for the curve roadway section was developed to determine the interrelationship of indirect variables. According to the values achieved, it was clear that the distance to the roadside objectives and width of the pedestrian walking path were highly co-related variables with a "R-squared" value of 0.75.

The vegetation density and the walking path width were observed to have the same relationship with a "P-value" below 0.05. Therefore, walking path width could be excluded from the model as in the first phase.

TABLE 3- CORRELATION COEFFICIENT METRIX

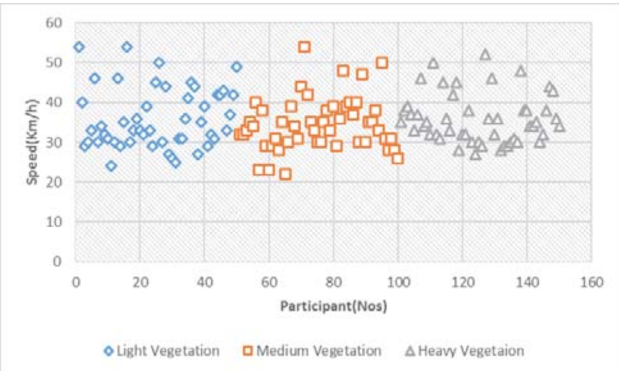
| Variable | GD | AD | VC | PO | NP | RO | WW | VD |
|---|---|---|---|---|---|---|---|---|
| GD | | 0.016 | 0.025 | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 |
| AD | 0.016 | | 0.004 | 0.011 | 0.000 | 0.002 | 0.013 | 0.021 |
| VC | 0.025 | 0.004 | | 0.029 | 0.001 | 0.002 | 0.007 | 0.009 |
| PO | 0.000 | 0.011 | 0.029 | | 0.005 | 0.011 | 0.043 | 0.064 |
| NP | 0.000 | 0.000 | 0.001 | 0.005 | | 0.000 | 0.004 | 0.010 |
| RO | 0.001 | 0.002 | 0.002 | 0.011 | 0.000 | | 0.750 | 0.250 |
| WW | 0.001 | 0.013 | 0.007 | 0.043 | 0.004 | 0.750 | | 0.750 |
| VD | 0.000 | 0.021 | 0.009 | 0.064 | 0.010 | 0.250 | 0.750 | |

The Backward elimination technique was used to generate logistic regression models. This method initially involved all the indirect variables and each variable was tested under a criterion which the "*P-value*" is less or greater than the significance level (0.05). If the "*P-value*" is greater than the significance level, then that variable or variables could be excluded from the model generating a new model. This process could continue until no further improvement was possible. The final updated model consisted of the most significant indirect variables for the direct variable.

## IV. Results and Discussion

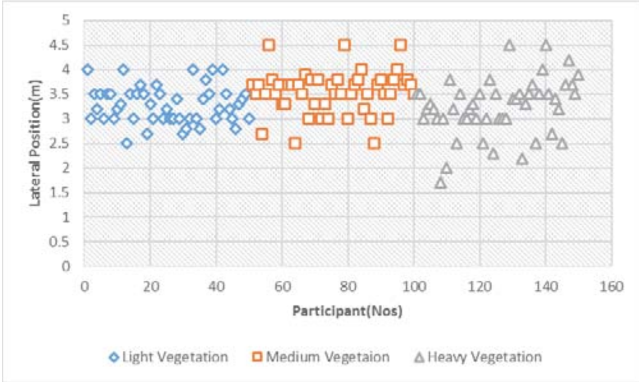
### A. *Straight Roadway section*

Speed variation with varying roadside vegetation densities has been plotted in Figure 1.




Speed variation versus varying vegitation

It was clearly seen varying roadside vegetation did not create an impact on speed selection of the drivers. The average speed on each location was approximately 35 Km/h. Figure 2 has been plotted to show the variation of lateral position of each vehicle in varying roadside vegetation densities. The average lateral position values were shifted in the upward direction with the location change from light to medium. Average lateral position values in light and medium vegetation location are 3.3m and 2.5m respectively. Heavy vegetation density location has more scattered lateral position values when comparing to other two locations with an average of 3.3m.




Lateral position vs varying vegitation

#### 1) *Speed Model*

A multinomial regression model was developed to investigate the vehicle speed on the roadway section. Speed was the dependent variable and vehicle condition, passengers on board, pedestrians traveling, distance to the nearest tree, and the vegetation density were the independent variables for the model. *R-squared* value of the model was 0.309. It suggested that 30.9 percent variance could be expected in criterion variable (Speed) alone in the model. The '*F-value'* was 9.091 whose *p-value* was < 0.05, therefore, the developed model could be accepted under 95% confident level.

The developed model for vehicle speed is shown in Table 3. The coefficients estimated together with the individual *p-value* for each variable were tabulated. If the *p-value* for a variable is less than 0.05, then it could be considered as a significant variable in the model. With this results, it could be concluded that all the variables expect gender of the driver were not significant. The considered independent variables do not provide significant effect to the dependent variable.

TABLE 3. Speed Model Results

| Variables | Coefficient Estimates | t | p-value |
|---|---|---|---|
| Constant | - | 12.196 | 0.000 |
| Gender of the driver | -0.670 | -5.769 | 0.000 |
| Approximate age of the driver | 0.008 | 0.100 | 0.920 |
| Vehicle condition | 0.172 | 1.446 | 0.150 |
| Passengers on board | 0.010 | 0.128 | 0.898 |
| Passengers travelling on the road | 0.048 | 0.600 | 0.549 |
| Distance to nearest tree | -0.098 | -1.218 | 0.225 |
| Vegetation Density | -0.051 | -0.609 | 0.544 |

#### 2) *Lateral Position Model*

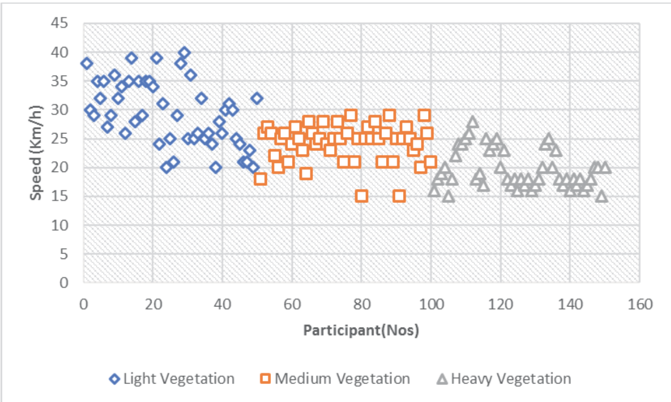
Lateral position was the dependent variable and all the independent variables which were considered for the speed model were included as independent variables. *R-squared* value for the model was 0.435, indicating 43.5 percent variance in criterion variable was accounted by the model alone. The significant *F-value* (9.091, p<0.05) for the model indicated that regression model could be accepted. Table 4 provides the coefficient estimates and the *p-values* of each variable. Gender of the driver and passengers onboard were the most significant variables having a *p-value* less than 0.05.

TABLE 4. Lateral Position Model Results

| Variables | Coefficient Estimates | t | p-value |
|---|---|---|---|
| Constant | - | 11.452 | 0.000 |
| Gender of the driver | -0.106 | -1.009 | 0.314 |
| Approximate age of the driver | -0.463 | -6.308 | 0.000 |
| Vehicle condition | 0.081 | 0.754 | 0.452 |
| Passengers on board | 0.250 | 3.475 | 0.001 |
| Passengers travelling on the road | 0.008 | 0.114 | 0.910 |
| Distance to nearest tree | 0.084 | 1.160 | 0.248 |
| Vegetation Density | 0.056 | 0.739 | 0.461 |

*3) Curved Roadway section*

The speed variation with varying roadside vegetation densities was plotted in Figure 3. The impact of varying roadside vegetation to speed selection of drivers could be clearly identified by the plotted graph. The average speed on light vegetated location was 29.4 Km/h and it had decreased to 24.2Km/h and 19.6Km/h when the landscape changes to medium vegetation and heavy vegetation respectively.




Speed variation versus varying vegitation

Figure 4 shows the variation of lateral position of each vehicle in varying roadside vegetation densities. The average lateral position values were shifted in the upward direction with the location change from light to medium which was similar to that of the straight roadway section. Average lateral position values change from 1.8 m to 1.9 m and 2.1 m with changing landscape from light to medium and light to heavy respectively.

*4) Speed Model*

In the first step of backward elimination logistic regression method, speed was the dependent variable and age of the driver, gender of the driver, vehicle condition, passengers on board, pedestrians traveling, distance to the nearest tree, and the vegetation density were the independent variables for the model. The maximum "*P-value*" observed was 0.646 (>0.05), therefore "Distance to nearest tree" variable was excluded from the model in the first step.

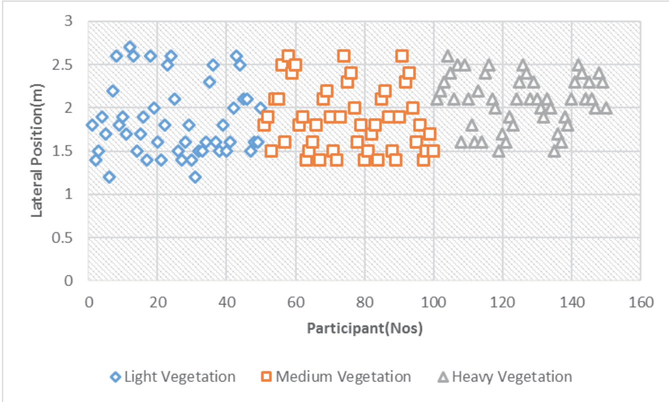



Fig. 4. Lateral Position variation versus varying vegitation at straight section

The same data set was analyzed excluding "RO" variable in the second step. The variable "NP" had the maximum "*P-value*" (=0.108>0.005), therefore it was excluded from the model. In the 3rd step all the variables had a satisfactory *P-value* (<0.05), therefore five indirect variables (GD, AD, VC, PO, NP, RO, VD) were selected to generate the Speed model. The "*R-squared"* value for the developed model was 0.571. It suggested that 51.1 percent variance could be expected in the criterion variable (Speed) alone in the model. The '*F-value'* was 38.4 whose *p-value* was < 0.05, therefore, the developed model could be accepted under a 95% confident level.

TABLE 5. Speed Model Results

| Variables | Coefficient Estimates | T-values | P-value |
|---|---|---|---|
| Constant | - | 25.064 | 0.000 |
| Gender of the driver | -0.228 | -4.088 | 0.000 |
| Approximate age of the driver | 0.108 | 1.912 | 0.054 |
| Vehicle condition | -0.108 | -1.924 | 0.053 |
| Passengers on board | -0.121 | -2.090 | 0.038 |
| Vegetation Density | -0.711 | -12.372 | 0.000 |

*5) Lateral Position Model*

The backward elimination logistic regression method was applied to generate the model for the Lateral Position. Seven indirect variables were used at the initial stage of the model. Six steps of backward elimination were performed to achieve the required significance level. At each stage, the variable which was having the maximum "*P-value*" was excluded from the model. Five variables including GD, VC, PO, NP and RO removed from the final modified model due to low significance levels. The "*R-squared*" value for the developed model was 0.321. It suggested that 32.1 percent variance could be expected in criterion variable (Lateral Position) alone in the model. The *'F-value'* was 34.7 whose *p-value* was < 0.05, therefore, the developed model could be accepted under a 95% confident level. And the estimated coefficients were tabulated in Table 6.

TABLE 6. Lateral position Model Results

| Variables | Coefficient Estimates | T-value | P-value |
|---|---|---|---|
| Constant | - | 37.494 | 0.000 |
| Approximate age of the driver | -0.515 | -7.501 | 0.000 |
| Vegetation Density | 0.171 | 2.495 | 0.014 |

## CONCLUSIONS

The preliminary analysis in the research was conducted using the variance of a single variable (Vegetation Density) with speed and lateral position. Based on the analysis on straight roadway section, it was found that changing vegetation did not affect the speed selection of the driver. But increasing the vegetation density had a positive impact on the increasing lateral position of the vehicle. At horizontal curve roadway sections, there was a significant effect of roadside vegetation to both speed and lateral position.

Speed and lateral position of the vehicle depend on different types of variables including the driver characteristics, roadway characteristics, and weather conditions. In each phase the study was conducted in two stages. During the first stage of the study, the critical variables which creates a significant impact to speed selection and lateral position of the vehicle were discovered. Required data were collected in the second stage of the study according to the discovered variables. In each phase two models were created for the speed and the lateral position. The models created in the first phase, did not provide a comprehensive output due to the less significant level of variables. But the models generated at the second phase of the study were able to provide comprehensive output on how vegetation density affect the drivers' speed selection and the lateral position of the vehicle.

Developed models also predict the speed selection of drivers and lateral positioning of the vehicles on straight and curve roadway section. A significant variance was shown in speed and lateral positioning of vehicles in the roads in both road sections, where roadside vegetation was high and low. In lightly vegetated roadway, subjects drove faster and drove much closer to the edge of the road. When the landscape changes to more vegetated, subjects drove much slower and drove closer to the center of the road. The developed models showed that the effect of road side vegetation was much higher in horizontal curve sections than in straight sections.

The roadside vegetation influenced the drivers' speed selection and positioning of the vehicle on the road. Therefore, it is a necessity that the road designers would consider the effect of roadside vegetation on designing the roadway sections. Ultimately, it would reduce the number of ROR crashes happening in the country.

## RECOMMONDATIONS

It was found that the road side vegetation at curved road sections have a substantial effect to the drivers' speed selection and lateral positioning on the road than at straight road way sections. The selected straight road sections in the study may not be highly suitable for providing a comprehensive output. Therefore, it is recommended to conduct the survey at a "B class" straight roadway section away from Colombo city, having road side vegetation beside the road.

Curved roadway sections have a considerable impact of roadside vegetation to drivers' speed selection and positioning of vehicle on the road. There should be proper standards and guidelines for road side vegetation. The distance of the clearance zone, the distance between trees, the maximum height of a tree are parameters which the authority must define for these roadway sections. Furthermore, laws and regulations should be implemented in the country to provoke public and other concerned parties to follow them.

It is recommended to post a speed limit sign at each critical curved road sections in the country. The speed estimates should involve the effect of roadside vegetation, and there should be a proper monitoring system to investigate the reaction of the drivers. Increasing the number of traffic police patrols on these road sections is another recommendation. The effect of the road side vegetation to driver's behavior, should be emphasized to the public. It is recommended to hold presentations, discussions, and television programmers to educate the public regarding road side elements.

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