A Study on Pedestrian Crossings in Colombo Suburbs

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***Abstract*— A pedestrian crossing is a location on a street which is designated for pedestrians to cross streets. According to the National Council for Road Safety (NCRS), more than 900 fatalities have occurred due to the crashes on or near pedestrian crossings during past 10 years in Sri Lanka. However, little research has been carried out in this regard. This study identified issues related to design of pedestrian crossings in Colombo area through observations and interviewing both road users and law enforcement authorities. This study highlights issues related to pedestrian crossing designs and give recommendations in accordance with international standards to make them safe for all road users.**

Keywords—Pedestrian Safety, Pedestrian Crossing Design

I. Introduction

At pedestrian crossings, pedestrians will have the right of access. In few European countries including United Kingdom (UK) give pedestrians right of way as soon as they step on the crossing whereas in other countries including Sri Lanka, pedestrians will have to start crossing the street to get right of access. Pedestrian crossings can be found at intersections and other parts of a road system where it would be otherwise dangerous to cross the street without assistance due to number of vehicles, speed, and width of the street. There are many variations of pedestrian crossings around the world. These variations are so widespread that countries such as United States (US) has regional variations of pedestrian crossings as well [1]. In a broader view, pedestrian crossings can be classified as signalized crossings and un-signalized crossings. Signalized crossings are control devices clearly separate pedestrians from vehicles at the area of crossing. These can be often seen in busy intersections or in streets where high traffic volume is anticipated. Un-signalized crossings are pedestrian crossings which generally assist pedestrians and usually prioritize them.

In Sri Lanka two main types of pedestrian activated crossings exist. The most commonly encountered type is the 'Zebra crossing'. Its distinguishing feature is the alternating dark and light strips on the road surface, resembling the coat of a zebra. In Sri Lanka, the light coloured strips are painted in amber colour and the rest is left unpainted because the road surface itself is dark. Zigzag lines and no parking lines are painted in the run up to the crossing to warn motorists of an approaching pedestrian crossing and to enforce no parking. Other type is Pedestrian Light Controlled crossing (Pelican crossings) are usually placed in intersections, streets with high vehicle flow, and at locations where vulnerable road users such as school children, elderly people cross the road regularly. A push button and two coloured pictograms facing the pedestrians in either side of the crossing will be placed. A separate phase for pedestrians is embedded to the traffic light system, if it is located at an intersection or otherwise pressing the button will stop the traffic in regular intervals to let the pedestrians to cross the road.

Pedestrians represent the most vulnerable, frequent, slowest, and unprotected type of traffic or movement, who walk on foot or use human driven means of transportation. Areas of pedestrian movement are rarely intended only for pedestrians, but are usually shared with other forms of transportation means. Pedestrian crossing is an important element in a road network which is designated for safe crossing purposes of pedestrians. However, crossings also create frequent conflicts between pedestrians and vehicles. Marked crossings can give a sense of false security which makes pedestrians enter without assessing the traffic situation. Pedestrians also presume vehicles would stop at any instance. The fatalities that occurred on or near pedestrian crossings in Sri Lanka during last 10 years are presented in Table 1 [2].

TABLE I. Pedestrian Fatalities at Pedestrian Crossings in Sri Lanka

Year	Number fatalities at pedestrian crossings
2006	61
2007	91
2008	71
2009	94
2010	120
2011	110
2012	110

It can be seen annual fatalities on pedestrian crossings have gradually increased over the years and this trend can be justified by the increased use of vehicles. New vehicle registrations are increasing in double-digit percentages yearly with the highest vehicle sales recorded in 2015 [2]. The NCRS stated that ten pedestrian crossing fatalities had occurred from January 1st to 31st of 2016 [3]. Additionally there had also been 201 crashes during the same period in which 206 lives were lost. The NCRS states that low-standard of pedestrian crossings is one of the main factors that contribute to crashes and fatalities involving pedestrian crossings. The importance of giving careful attention in planning, designing, constructing

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and signing of pedestrian crossings was emphasized by NCRS. In the most recent development, NCRS has decided to remove 55 high-risk pedestrian crossings in Colombo [4]. Substantial amount of research has not been carried out locally to uncover these issues and to come up with design recommendations to improve safety of pedestrian crossings. There are many improperly planned and potentially dangerous crossings all over Sri Lanka.

II. LITERATURE REVIEW

Most of pedestrian related research studies mainly on pedestrian characteristics which are important in pedestrian crossing design. Linear regression and logit modelling were used to analyze crash data of signalized crossings for 14 years (1993-2006) in Edinburg, Ireland [5]. It identified the most risky location of a pedestrian crossing was within 10m of the crossing and 10-30m before the pedestrian crossing. Level of risk could eventually increase to high levels for pedestrians who cross the road near pedestrian crossings. Un-signalized crossings were found to be considerably less safe than signalized or supervised crossings [6]. Corben and Diamantopolou introduced guidelines on provisions for vulnerable pedestrians, distances between crossing facilities and strategic planning measures to reduce crashes and improve safety of crossings [6].

Providing raised medians on multilane roads and good illumination of crossing facilities can substantially reduce pedestrian crash risk. Textured pavements, audible pedestrian signals, wheelchair ramps and larger signs should be provided for convenience of the disabled people at crossing facilities [7]. Overpasses and underpasses can greatly improve pedestrian safety but should be designed such that pedestrians are encouraged to use the facilities. An analysis between 1,000 marked and 1,000 similar unmarked pedestrian crossings at uncontrolled locations in 30 different cities was carried out [8]. Marked crossings are crossing facilities with painted strips on the pavement. Unmarked crossings are designated crossings locations which aren't painted but give right-of-way to pedestrians. The results revealed that pedestrians were likely to get involved in crashes on marked crossings rather than unmarked crossings in roads with high traffic volumes.

The Analytical Hierarchy Process was proposed to be used to prioritize new pedestrian crossing proposals received by the transportation agency of Slovenia [9]. Selection of criteria such as vehicle and pedestrian traffic, road geometry and sight distance, distance between neighboring crossings and intersections, illumination, and crossing islands were justified in accordance with road design standards. Raised medians in multi-lane roads showed significantly less crash rates compared with roads without raised medians. The sight distance, Level of Service (LOS), and delay to pedestrians were considered as major terms to be considered prior to installing pedestrian crossings [10]. Kaluarachchi introduced a guideline to assist in determining appropriate crossing facility for a given location based on above terms [10].

Some countries in the world developed pedestrian crossing design standards and some of those are referred in this study. 'Pedestrian Planning and Design Guide: Design of Crossings' published by New Zealand transport agency covered design of crossing facilities at and away from intersections, requirements of pedestrians, requirements of drivers, different crossing types specifications, accessibility features to support elders and differently-abled persons, landscaping near crossings, and safety concerns of students at crossings near schools [11]. 'The Design of Pedestrian Crossings – Local Transport Note 2/95', published by the department of transport UK specifies statuary requirements; assessment of crossings; and design guidelines for various at-grade crossings such as zebra, signal-controlled, pelican, puffin, and toucan [12].'Planning and Designing for Pedestrians: Guidelines' published by department of transport, Western Australia defined design direction for pedestrian crossings facilities that includes mid-block crossings, non-signalized and signalized intersection crossings, grade separated crossings, and railway crossings in Western Australia [13]. Furthermore guidance in the areas of assisting differently-abled persons, lighting, warning signs and traffic calming are also provided. Apart from above, specific clauses from German and North American Design Standards were also referred.

III. METHODOLOGY

There are hundreds of pedestrian crossings located around Sri Lanka in urban, sub-urban, and rural streets. Assessing pedestrian crossings for their design weaknesses in a wide area of Sri Lanka would produce a good overview. However, due to practical limitations, a study area which covers sub-urban setups were chosen. The study area has a fair mix of both A-class, B-class, and C-class streets which contain many pedestrian crossings. Classification of all roads in Sri Lanka is done by the Road Development Authority (RDA) [14]. According to RDA, streets chosen in study are classified as, class-A for Highlevel road, class-B for New-Kandy road, and class-C feeder road for Hokandara – Thalawathugoda road. The streets considered in the study were:

- About 8.2 km long road section at Highlevel Road (A4) from Kottawa junction to Nugegoda junction which consisting 39 un-signalized Zebra crossings;
- About 2.7 km long road section at New-Kandy Road (B263) from Malabe junction to SLIIT, Malabe which consisting seven un-signalized Zebra crossings and one signalized Pelican crossing; and
- About 2.9 km long road section at Thalawathugoda – Hokandara Road consisting five un-signalized Zebra crossings.

The initial stage of the research engaged in identifying potential issues of implementation, design, construction, and operation of pedestrian crossings in the study area. Data collection was carried out mainly using face-to-face interviews and discussions with traffic Police officers in the study area; face-to-face interviews with arbitrarily selected representative sample of 28 road users which including pedestrians (13), taxi-drivers (7) and bus-drivers (8) in the study area; and Field observations. Traffic Police Departments of Maharagama and Mirihana were visited to collect data as study area was under those police administrative areas. Road users were interviewed in cities of Nugegoda, Kottawa and Malabe. They were each asked to give three issues of pedestrian crossings as

experienced by them. Options to select were not given as it would then be not represent the genuine insights of individuals. However, during explanation a sample example was provided verbally, taking into account whether the person was a pedestrian, taxi-driver, or bus driver. Based on the collected data pedestrian crossings design issues were identified as outlined by road design standards and studies conducted locally and internationally.

IV. Results

Table II shows the issues at the pedestrian crossing identified by the road users. It can be noticed that most of the responses were in laymen terms and did not directly outline design related issues of the pedestrian crossings. Data well represents the issues in each category of the responders had to face but sample size was not sufficient to do statistical analysis. The majority of the pedestrians had stated that motorists do not yield them at the crossing. In the other hand, most of the drivers responded saying that pedestrians start crossing the road suddenly.

TABLE II. Issues Identified by Road Users

Type of the Issue	Number of Responses		
	Pedestrians	Taxi Drivers	Bus Drivers
Motorists not yielding for pedestrians	13	4	2
Pedestrians start to cross the road suddenly	1	4	8
Bad visibility at night	1	3	1
Parked vehicles obstructing the crossing	3	1	0
Inappropriate locations	7	4	1
Crossing erased	4	2	2
Crossings placed too close to each other	0	0	2
Pedestrians crossing the road untimely	2	3	6
Pedestrian crossing too long to cross	8	0	2
Total responses	39	21	24

Table III summarizes the design issues that were discovered in the pedestrian crossings in the study area, listed according to the frequency of occurrence. Frequency of occurrence was determined by field observations.

TABLE III Issues in Pedestrian Crossings

Identified Design Issue	Number of Crossings and Presentage of Occurance							
	Highlevel Road		*New-Kandy Road*		*Hokandara Road*		*All Three Road Sections*	
	Num.	*%*	*Num*	*%*	*Num*	*%*	*Num*	*%*
Bad visibility at night	24	62	4	50	5	100	33	63
Too long to crossings	30	77	2	25	0	0	32	62
Built in dangerous locations	17	44	2	25	1	20	20	38
No speed restrictions	8	21	2	25	1	20	11	21
Uncontrolled crossing	9	23	1	13	0	0	10	19
Insufficient road markings and signs	3	8	0	0	5	100	8	15
Low protection for vulnerable users	6	15	1	13	1	20	8	15
Bad pavemnet conditions near crossing	2	5	0	0	4	80	6	12

According to Table II, it should be noticed that all pedestrians who were interviewed had stated that motorists do not yield while crossing the road. Weak driving ethics and frustration due to slow moving traffic in urban set ups could be psychological reasons for drivers not yielding for pedestrians. Interestingly, design issues related to this responses are seen in Table III. Crossing too long (longer waiting time for drivers) and uncontrolled crossings at locations with high vehicle and pedestrian flow are justifiable design issues which cause drivers not to yield for pedestrians [1, 3]. The percentage of each identified issue was estimated for the all three road sections separately and a summary of issues present in each stretch and as a whole in the study area was given in Table III. According to the study, following points can be brought forward for each road section.

A. Highlevel Road Section:

Seven pedestrian crossings out of 39 were found to have no significant design issue. Most common issues were the unsafe distance which pedestrians have to cross in a single movement, weak night time visibility, and hazards near the crossings such as unsafe placement of bus stops, being too close to intersections and placement near bends and crest sections of hills. Pavement conditions were well maintained on and around the crossings. Pedestrian crossings in front of schools did not provided adequate safety for children. Pedestrian crossings in highly active city sections, particularly in city centers of Nugegoda, Maharagama, and Kottawa did not cater the pedestrian requirements and as a result major traffic disruptions and delays could be noticed.

B. New-Kandy Road Section

Three out of eight pedestrian crossings were found to have no significant design issue. Most common issues were the bad night-time visibility, crossing distance, unsuitable location placement with respect to sharp bends and crest sections of hills of the road, and lack of speed calming techniques. Pedestrian crossing in Malabe junction had multiple issues regarding location with respect to bus stop, lack of protection for school children, crossing distance, and disturbance to traffic movement.

C. Hokandara Road Section

No pedestrian crossing in the study area met the minimum night-time visibility requirements. Road conditions near and on pedestrian crossings were not up to the standards, making the crossings potentially hazardous. Required warning signs were not provided and paint was erased almost in every Crossing. Vegetation growth in the road sides of the road and lack of vehicle parking restrictions near crossings made visual obstructions for drivers.

V. Discussion

Recommendations to improve the pedestrian crossing addressing each identified problem were discussed in this section.

A. Weak Visibility of Crossing at Night

1) Description: Weak visibility of crossings was one of the most common issues found in pedestrian crossings in Sri Lanka. During the interviews with Police officers, it was revealed that Police Department has identified bad visibility of crossings was one of the main reasons contribute to

pedestrian-traffic conflicts in Sri Lanka. Lighting of crossings in overall can be classified into two:

i. Illumination of crossing area:– The crossing should have a contrast with the general street lighting. In minimum, crossing should be at least lit with street lighting.

ii. Warning lights:– These systems warn drivers of the approaching pedestrian crossing. Pole mounted illuminated globes (Belicha beacons) were put up near crossings in urban areas of Sri Lanka. Reflective devices such as pedestrian crossing signboard, road markings (Zigzag lines) and surface embedded reflectors are categorized under warning lights.

2) Effects: Bad visibility can cause drivers not being able to see pedestrians on the crossing until they have exceeded the safe stopping distance. The glare from the headlights of oncoming vehicles could obstruct the visibility of drivers. Drivers won't have sufficient time to stop their vehicles and would be forced to make dangerous maneuvers risking pedestrians as well as other motorists.

3) Solutions: Immediate precaution should be taken to fulfill the minimum lighting requirements of the pedestrian crossings. Australian/New Zealand standards specify lighting requirements as crossings shall be remained illuminated at night even it is not being used [11, 13]. It further states Crossing Poles (reflectorized black and white poles, at least 2m high and 75mm wide) to be installed within 2m upstream of each end of the crossing including on pedestrian islands and providing an internally lit flashing amber beacon, or fluorescent orange disc (at least 300mm diameter) mounted on the crossing poles.

B. Pedestrians Have to Cross an Unsafe Distance in a Single Movement.

1) Description: There were many un-signalized zebra crossings in the study area which pedestrians have to travel the entire width of the road in a single movement. Mostly such crossings were situated in unidirectional multi-lane roads which also accompanies large number of traffic. During face-to-face interviews with traffic Police officers bound to Maharagama Police Station said that the identified crossings are causing many crashes and has contributed to traffic congestion as well.

2) Effects: Pedestrians will have to travel an unsafe distance along the crossing. They will take a longer time to reach the other end of the crossing. This will build frustration among motorists and they may tend to move along while people are already crossing. This worsens the situation for the most vulnerable groups of pedestrians such as young school children, elderly, and differently abled persons.

3) Solutions: Pedestrian crossings should be designed such that pedestrians will have to travel the shortest distance possible. The New Zealand standards state that the maximum safe distance a pedestrian can cross in a single movement should be limited to 10m [11]. Where a longer distance is likely, installing pedestrian islands could be the best solution. It will let pedestrians cross the road in two movements and provide sufficient protection from traffic at the middle of the road. According to standards, Pedestrian Island should be at least 8m long and 1.8m wide. Width of route through island shall be at least 1.5m.

C. Built in Potentially Dangerous Locations

1) Description: When referred in conjunction with international standards, locating many pedestrian crossing in the study area were questionable. Most common problems with respect to the placement of pedestrian crossing arise when they are located near intersections, near bus stops, near horizontal and vertical curved sections of road or too close to other crossings.

2) Effects: Drivers' behavior near an intersection could be shifted more towards assessing other motor traffic rather which creates a hazardous environment for people who use the crossing. Bus drivers as well as other motorists try to overtake stopped busses at a bus stop. Crossings situated unsafely close to curves of the road could be very dangerous as drivers will not be able to see pedestrians on time leaving them with little time to react.

3) Solutions: Following guidelines are according to British Road Design Standards [12];

a) Placement with respect to neighboring intersections: When the existing or planned pedestrian crossing is within the area of road intersection or less than 100m away from intersection, the pedestrian crossing should be marked in the area of intersection. Inclusion of a signalized phase for the pedestrians will be convenient. If the distance between two consecutive intersections is very small (<100m), the pedestrian crossing can be also built in the middle between two intersections, as a joint pedestrian crossing for both intersections.

b) Placement near bus stop areas: When requirements for pedestrian cross marking near bus stops are met, it must be located ahead of bus stop entry, so that pedestrians can cross the road behind the stopped bus. Positioning between bus stops in both driving directions is possible when longitudinal shift of bus stops is maximum 30m or at least when longitudinal shift is as much as needed for the crossing width. If this shift is not possible, crossing shall not be introduced.

c) Distances between neighboring crossings: Pedestrian crossings are foreseen on distances of 200m apart and are at least 100m away from the closest road crossing, except when there are two neighboring crossings within 200m distance near schools, hospitals, and other public facilities.

d) Crossings located at bends and crest sections of a Hill: Both above situations will obstruct the view of the driver to see the pedestrian clearly. Western Australian road design standards states that such occurrences should be avoided. Further it states to avoid the bends and 'departure' sides of crests.

D. No Speed Restriction to the Run-up of Crossing

1) Description: Sri Lanka has a maximum allowable speed of 50km/h in built-up areas and 70km/h in outside built-up areas. However, drivers tend to dangerously overtake and speed in straight road sections even it is located in an urban set up. In

such an environment, it makes pedestrians extremely vulnerable to crashes.

2) Effects: Driving above the speed limit means a vehicle will not be able to stop in time even though safe sight distance is provided. Western Australian road design standards specifically states that zebra crossings are unsuitable for roads with maximum posted speed of 50kmph and maximum 85th percentile speed of 60kmph [13].

3) Solutions: It should be checked if the minimum approach sight distance for pedestrian crossing against the design speed of the road is achieved. Providing passive measures to reduce speed of vehicles are needed at road sections where drivers are susceptible to over-speed. Understanding road geometry and studying crash data are important to identify such locations. Most important measure is to fix reflective sign boards with the speed limit of the road. Signboards warning of the approaching pedestrian crossing should be displayed. Speed strips also known as Rumble Strips can be fixed before the crossing in both directions of traffic. It produces a vibration and an audible rumbling which would warn drivers of approaching crossing Alternating amber coloured LED lamps can be fixed in either side of the crossing if the potential of a crash to occur is high.

E. Uncontrolled Crossings at Locations with High Vehicle and Pedestrian Volume

1) Description: Mid-block signalized pedestrian crossings are installed at locations where there are high flow of pedestrians to cross the road regularly. After visual observations and discussions with traffic Police officers, it was realized that there are many crossings in the study area, causing problems by remaining un-signalized.

2) Effects: Not having a signalized crossing at a location where it needs to have one causes disruptions to the traffic. This is caused when pedestrians start crossing the road in regular intervals. The added waiting time can cause more traffic especially during peak traffic hours. Travelling through such road sections can be very uncomfortable for passengers in vehicles.

3) Solutions: German road design standards has specified guidelines on this regard [6]. According to the guidelines, introducing a signalized phase shall be considered, if over 100 pedestrians per hour and over 600 motorized vehicles per hour conditions are met. There is a thumb of rule used by transportation experts in Europe to determine when signalized crossings shall need to be installed. According to them the minimum flow rates for a crossings to be signalized are, 400 vehicles per hour and 300 pedestrians per hour [6]. Using signalized crossings at locations where most vulnerable pedestrians cross the roads is also proposed and further discussed under section G.

F. Insufficiently Provided Road Markings

1) Description: Faded off pedestrian crossings is a common sight in Sri Lanka. With time, the paint on the crossing deteriorates and will need repainting or maintenance. At most occasions, after a pavement overlay or resurfacing, road authorities take a long time to mark pedestrian crossing at the locations where it was before. Inadequate road markings such as absent warning signs, markings of Zigzag lines and no parking zones were also common to be seen. Some crossings in the study area were only painted strips without any other markings.

2) Effects: Crashes can occur inevitably as a result of inadequate road markings. Drivers will not be able to realize that they are approaching to a pedestrian crossing if the paint has erased. Pedestrians who use a crossing even after it is faded off are faced with even more danger. Pedestrians will eventually cross the road at the location where the crossing was earlier.

3) Solutions: Drivers will instinctively pay more attention to the road, if adequate road signs and markings are provided. One of the recommendations that can be brought is to mark the Zigzag lines for every zebra pedestrian crossing. Road design standards state that no-parking zone should be at least 6m long from the crossing with 15m being preferable [11,12]. Australian standards state that parking of vehicles shall be prohibited for a minimum of 20m in the approach and 10m in the departure sides of a pedestrian crossing where kerb protrusions are not provided. Police can frequently enforce this law although it is not practical for an officer to be permanently assigned to take down violators.

G. Lack of Protection for Vulnerable Road Users

1) Description: School children and elderly persons are the most vulnerable group of pedestrians. Young children have not developed the perception of speed and thus cannot judge speed of oncoming traffic. Elderly people who regularly cross the roads near hospitals are as vulnerable as young children. However, little consideration of their needs have taken into account when designing crossing facilities. As an example, there are at least four schools in a stretch less than 400m in Nugegoda junction which are served by four traditional zebra crossings without special methodology to reinforce the protection of many young children who use these crossings daily.

2) Effects: School children are prone to crashes due to their unpredictable behavior. They can either cross the road before vehicles are fully halted or start crossing the road late. Similarly, walking speed of elderly persons are slower than that of younger pedestrians. This can lead to pedestrian- motor vehicles collisions if the crossing is not manned or signalized.

3) Solutions: Setting up "Pedestrian Platforms' with zebra crossing marked on them (also called as 'Wombat Crossings in Australia) can be proposed to be used near schools [13]. Wombat crossings has same advantages as zebra crossings and is appropriate to use near schools and which has two-lane roads with short crossing distances, low traffic volumes and consistent pedestrian usage. Raised platform will increase visibility of the crossing and force motorists to slow down. Western Australia standards specify platform shall be 100mm high and a 'Road Hump Ahead' sign to be installed ahead of the crossing.

Another solution is to use speed humps and/or speed strips before and after the crossing. Signalizing the pedestrian crossings near hospitals can be proposed [11, 13]. Walking

speed of elderly persons are the lowest (I.e. An elderly person's walking speed ~1.0-1.2 m/s against 1.5 m/s of a fit person) [13]. Pedestrian phase timing of signalized crossing shall be determined according to this. Usually there is a heavy and a consistent pedestrian volume near hospitals, therefore installing mid-block signalized pedestrian crossings can be justified.

H. Bad Road Conditions Near Crossings

1) Description: Adverse road conditions near pedestrian crossings can make the crossing dangerous. Road surface should facilitate drivers in an event of a sudden braking. Damaged surfaces may not provide sufficient support during such an occasion. Uneven surfaces and potholes near crossings were observed in the road sections of the study area. It has been discovered that cyclists and bikers are at risk of slipping due to the material used to paint pedestrian crossing and other road markings.

2) Effects: Damaged, slippery, and uneven road surfaces could cause crashes during an event which requires driver's sudden reaction. Motorists might pay more attention to avoid pot holes in the approach of a crossing and would pay less attention towards the crossing. Vehicles could also skid near the crossing, if roughness of surface is not maintained.

3) Solutions: Road surface approaching to pedestrian crossings should be always maintained in perfect condition in order to provide maximum grip [11, 12]. Local authorities should make a comprehensive program to assess road conditions near crossings time to time and maintain, if needed. In the construction phase, attention should be given to have a good balance between surface roughness and passenger comfort. Less slippery paint can be imported or developed locally to mark crossings if necessary.

II. V. RECOMMENDATIONS

Providing proper lighting to all pedestrian crossings is a must. Surface embedded reflectors can be installed on crossing surface and on Zigzag lines. Installing refuge islands at long crossings and raised center medians in the approach are advisable. Extreme care should be taken to choose a proper place to locate crossing considering road geometry, bus stops, intersections, and neighboring crossings. For busy city stretches, a coordinate traffic light system to manage pedestrian movement can be proposed. Constructing grade separated crossings will be the cheaper alternative. Well-trained traffic wardens may be assigned to control traffic near crossings at schools at all times. Road sections near crossings would be free of potholes, manhole opening protrusions, and vegetation growth. Relevant administrative authority would set up units to assess conditions of pedestrian crossings in a regular basis.

Many authorities and organizations actively participate in transportation sector in Sri Lanka. Some of them are RDA, NCRS, provincial councils, local councils, and Police. They mainly represent road planning and design, road infrastructure construction, road safety, administration, and law enforcement. Lack of coordination and information sharing within these organizational elements can also be identified as a reason for existing unsafe pedestrian crossings. These organizations should closely coordinate with each other in order to conduct research, gather data, share information, apply new technology, and enforce law.

VI. CONCLUTIONS

The results showed disparities between pedestrian crossings and design guidelines. Eight design issues were identified and discussed with example(s) in the study area. The most common being bad night-time visibility, crossing being too long, and built in dangerous locations. Adhering design recommendations into Sri Lankan context, suitable measures to eliminate adverse effects were discussed in conjunction with international road design standards that were chosen. Finally, set of general recommendations to improve pedestrian crossing designs were highlighted considering the practicality and financial viability.

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